PROPAGATION & PRUNING

THE
PROPAGATION & PRUNING
OF
HARDY TREES, SHRUBS, & MISCELLANEOUS PLANTS

WITH CHAPTERS ON MANURING AND PLANTING

BY

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WITH NUMEROUS ILLUSTRATIONS

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TO

MY FRIEND

PROF. F. C. CAVERS, D.Sc., F.L.S.

Whom I have to thank for a more perfect knowledge of plant physiology, which has enabled me to better understand the principles underlying the practice of those operations which I have attempted to describe in this volume.

PREFACE

The study of horticulture is now attracting the attention of many whose practical knowledge of the subject is very limited. Efficiency in plant propagation and pruning can only be acquired by experience, and even among practical cultivators very few are sufficiently familiar with the habits and characteristics of temperate and tropical plants to enable them to write a complete treatise on the subject.

In the present volume I have endeavoured to give a brief account of the propagation and pruning of some plants which have come directly under my observation, with the hope that such remarks as I have ventured to make may prove of interest to those who are investigating plant propagation from either a practical or theoretical standpoint.

To some amateurs the propagation and pruning of fruit and other trees has appeared something of a mystery, but a perusal of this simple treatise should dispel what is nothing more than a delusion. Propagation may not concern the many who grow only a few trees in order to produce a sufficiency of fruit for their own needs, while on the other hand the subject of pruning cannot be ignored, and the sooner the principles underlying this important

operation are understood the better. Those who are engaged in plant propagation cannot fail to be impressed not only with the habits of plants generally, but also with the physical or constitutional differences of plants of the same genus, species, and variety.

I have endeavoured throughout the succeeding chapters to treat the whole subject in the simplest possible language, so that all who interest themselves in the growth of plants may glean something from these pages.

Practical experience has gone to show that a knowledge of the chemical constituents of which a plant is composed proves but a poor guide to its cultivation, or in selecting the kind of soil for which it is best suited. But, notwithstanding, it must be admitted that a knowledge of the plant's anatomy, and of the various chemical compounds of which it is made up, must to some extent guide the cultivator in determining what manures are best suited to its successful growth.

Again, the analysis of a soil does not always help the grower in determining what species of plant is best adapted for growth in that particular soil, but when collective information relating to soil and plant analysis and other equally important data are placed at his disposal, he may avoid many of the errors that befall the experimenter, who has no such knowledge at his command.

Soil and climate are so variable in this country that

hardy fruit culture can rarely be made a commercial success, except where ideal soil conditions exist, and every attention is given to spraying, grading, packing, and, in fact, everything that will tend to place the choicest quality of fruit upon the market.

Many orchards and the older gardens in this country contain worthless varieties of fruits, which ought to give place to some of the more improved sorts, or to those which experience has proved suitable to the locality. In many of these old orchards, which have been established say fifty years or more, the varieties of apples, even at the time they were planted, were much inferior to those of the present day. Growers should be alive to this fact, and root up those varieties which are no longer profitable.

I have purposely refrained from a reference to varieties of fruits, as I know of nothing more misleading than to recommend any particular variety of apple, or other fruit, to the public; this advice can be more ably given by a local nurseryman.

No better description of the relative merits of fruits can be obtained than is now given in the various trade catalogues published by our leading fruit-growers. Further than this, all the firms with which I am acquainted are always ready to give whatever advice is asked for with regard to the suitability to a certain district of any particular variety under consideration.

Characteristic differences are readily seen in the case

of the apple, where a variety will succeed under certain conditions and not under others, and where the habits of the respective trees are distinct from one another. It is in these and similar instances that the cultivator is called upon to exert his best powers of judgment, so that, aided by science, he can better grapple with Nature's laws, and produce those results which years of experience have taught him to be the best.

J. C. NEWSHAM.

OLD BASING, HANTS.

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PLANT PHYSIOLOGY

In order to understand properly the results of, and the reasons for, the various operations of horticulture, it is necessary to have some knowledge of the structure and physiology of plants. We must, for instance, know something of the sources whence the plant obtains its food; the processes by which the simple inorganic substances taken by the plant from the soil and the air are elaborated into the complex organic substances of which the plant's body is made up; the channels through which the raw materials and the elaborated foods are carried from place to place within the plant; and the influence of the various external factors of the plant's environment or surroundings, in the widest sense—including air, light, soil, etc.,—upon the life, nutrition, and growth of the plant.

If we make a chemical analysis of any flowering plant —for we are concerned here only with the higher plants—

we find that after driving off the water which all the tissues contain in greater or lesser proportions, the dried substance contains a considerable number of chemical elements, some of them in fairly large percentages and some in mere traces. We can find out which of these elements are absolutely necessary for the healthy growth of the plant by growing seedlings or cuttings in a "culture solution" consisting of certain salts dissolved in water. By this means we learn that for normal healthy growth the normal or complete solution must contain potash, lime, and magnesia, combined with nitric, sulphuric, and phosphoric acids, together with a trace of iron. That is to say, the essential elements which must be supplied to the roots of a green plant (a plant having normal green leaves) are only nine in number—potassium, calcium, magnesium, iron, nitrogen, sulphur, phosphorus, hydrogen, and oxygen. If the roots be supplied with an incomplete solution, from which any one of these nine elements is omitted, the growth of the plant is relatively poor and unhealthy, and ceases as soon as the plant has exhausted any store of the omitted element which may be already present in its tissues.

All parts of a flowering plant (roots, stems, leaves, etc.) are made up of closed chambers called cells, or of structures which have been derived from cells—the vessels of the wood, for instance, are developed from longitudinal rows of cells which have fused to form continuous tubes.

Cells vary in size and form, but all agree in consisting (at any rate when young) of a mass of protoplasm, which contains a special protoplasmic body called the nucleus and is enclosed by a cell-wall. Protoplasm is a mixture of the complex organic compounds called proteins, containing the six elements carbon, hydrogen, oxygen, nitrogen, sulphur, and phosphorus; the cell-wall consists of cellulose, which belongs to the carbohydrates and contains the elements carbon, hydrogen, and oxygen. The cell-wall is dead; in fact, the only parts of a plant which are alive and capable of growth are those in which there are cells containing protoplasm — "the physical basis of life." Carbon is an essential constituent of all organic substances, and the very fact that the six elements just named make up the living matter or protoplasm shows that we must add carbon to the list of essential elements for plant growth. There are, therefore, ten essential elements for the life and growth of green plants. Carbon need not be supplied in the culture solution, and indeed it is not utilised by the roots of the plant if it is supplied (for instance, in the form of a carbonate) to them, hence we conclude that carbon is absorbed from the air—in the form of carbon dioxide, which is everywhere present in the atmosphere; whereas the remaining nine elements must (in ordinary land-plants) be absorbed by the roots from the soil in the form of dissolved salts.

A young cell is entirely filled with protoplasm, which

is saturated with watery fluid. As the cell grows this fluid (cell-sap) increases in amount and becomes visible as small drops, and these eventually run together to form a single large drop, or vacuole, the protoplasm then becoming reduced to a thin layer just within the cell-wall; this change is due to the fact that the increase in amount of the protoplasm does not keep pace with the growth in volume of the entire cell. The cell-sap consists of water in which are dissolved various substances, both organic and inorganic—sugar, peptone, ferments, salts, organic acids, soluble colouring-matters (pigments), etc.; while the protoplasm may have various bodies embedded in it—chloroplasts (chlorophyll corpuscles), starch-grains, crystals, oil-drops, etc. The cell-wall may undergo various modifications in chemical composition and physical properties, as in woody tissue (fibres and vessels) and cork. The cell may retain its protoplasm and therefore remain capable of growing and dividing, as in the tissues of growing-points and in the cambium; or it may lose its protoplasm, and so become dead and capable only of serving purely mechanical functions such as strengthening the plant or conducting water. Fibres serve purely for strengthening the plant, vessels for strengthening purposes as well as the conduction of water.

In dicotyledons, both in herbaceous plants (*e.g.* sunflower) and in the youngest branches of woody plants (*e.g.* apple), the stem contains a number of strings or

vascular bundles arranged in a hollow cylinder (seen in cross-section as a ring, of course) and running parallel with each other along the stem. At the nodes (a node is simply the place where one or more leaves are inserted on the stem), these bundles run out into the leaf-blade (through the leaf-stalk if one is present) as the branched veins, while at the base of the stem they are continuous with the vascular bundles of the root. The young stem is covered by a single layer of cells called the epidermis, the surface of which is again covered by a film of cuticle, a modified cell-wall substance almost impermeable to water and gases; unaltered cellulose is quite permeable. Between the epidermis and the ring of bundles is a zone of tissue called the cortex, which is continuous with the central pith within the bundle-ring by means of the radiating medullary rays lying between the bundles themselves. The cortex, rays, and pith consist of angular or rounded cells and are collectively termed the ground tissue.

Each bundle (fig. 1) consists of three portions—the wood on the inner side, the phloem on the outer side, and the cambium in the middle. The wood consists mainly of vessels, the inner ones narrow and thickened with spiral or ring-like bands; while the outer ones are wider and have their walls thickened in such a manner as to leave a number of thin places called pits; besides these spiral, annular, and pitted vessels, the wood includes

ordinary living cells (wood parenchyma) and fibres. The phloem also contains conducting vessels called sieve-tubes, quite different from those of the wood; each sieve-tube is formed from a longitudinal row of cells, but the cross-walls in this case, instead of disappearing altogether as in wood vessels, are perforated like a sieve, and through these sieve-plates the contents are continuous from cell to cell along the sieve-tube; the sieve-tubes retain their protoplasm, and the cell-wall remains as cellulose, not undergoing conversion into woody substance as in the case of the wood vessels.

The cambium is a most important tissue, though it is much less conspicuous than the other tissues and forms a very thin layer. With the microscope it is easily recognised, for the cambium cells are arranged in regular radial rows and are brick-shaped, with very thin walls and abundant protoplasm. The cambium merges gradually into the wood on its inner side and into the phloem on its outer side; examination of older parts of the stem shows that the cambium cells are continually growing and dividing, the new cells produced internally developing into new wood constituents (vessels, fibres, parenchyma), and those produced externally into new phloem constituents (sieve-tubes, fibres in some plants, and parenchyma). Except in short-lived herbaceous plants, however, the cambium does not remain long as isolated strips between the wood and phloem of the bundles, for after

a time the cells of the rays between the bundles begin again to grow and divide, in such a way as to form new strips of cambium which become joined up to those in the original bundles, so as to form a continuous ring of cambium. This complete cambium layer then produces wood constituents and also rays (continuing the original rays and also producing new rays) on its inner side, and adds to the phloem on its outer side, all round the stem, so that the wood and cambium and phloem form concentric layers (fig. 2). Once started in this way, the secondary growth in thickness of the stem proceeds year by year, the greater part of the increase in thickness taking place in the wood, the "rings" in which correspond to the years of growth of the stem. The wood formed in spring has large vessels, which are required for the rapid transport of sap to the young leaves, and is of more open texture than the wood formed later in the year, as the rate of growth diminishes and the leaves require less sap and make less food. In autumn the formation of new wood ceases, reserve food is stored up in the phloem, wood parenchyma, rays, cortex, etc., and the resting buds are by this time about fully developed. In spring the buds open and the young leaves expand; the cambium again begins to grow actively and to form new "spring wood." The transition from spring wood to autumn wood may be gradual, but there is an abrupt change from the autumn wood (with narrow vessels) of one year to the

spring wood (with wide vessels) of the next, hence the "annual rings" are often very distinct.

Just as reproduction is obviously the all-important process from the point of view of the race, so photosynthesis is the central fact in the physiology of the individual plant. Photosynthesis is the name given to a series of processes by which the living protoplasm of green (chlorophyll-bearing) cells is enabled, by utilising the energy of sunlight absorbed by the chlorophyll, to re-arrange the elements carbon, hydrogen, and oxygen present in the carbon dioxide of the air and in water in such a manner as to build up organic substances of increasing complexity. The carbohydrates (sugar, starch) produced by photosynthesis are later combined with the elements nitrogen, sulphur, and phosphorus (present in the dissolved nitrates, sulphates, and phosphates absorbed from the soil-water) so as to form nitrogenous organic substances, producing proteins, and the series of building-up processes culminates in the formation of protoplasm itself. By making suitable experiments, such as are described in text-books of plant physiology,[1] we can easily prove that photosynthesis occurs only in the green parts of the plant, chiefly in the foliage-leaves; that it occurs only in light of sufficient intensity, and not at all in darkness; that a certain degree of warmth is essential, as

[1] See, for instance, *Practical Botany*, by Prof. Cavers (University Tutorial Press, 4s. 6d.).

in the case of any other vital process; and so on. The elements calcium, potassium, and magnesium are apparently essential, directly or indirectly, for photosynthesis. The green substance chlorophyll is only formed in the presence of light, warmth, oxygen, and iron, while it apparently contains magnesium as an essential element. The first complex organic compounds formed in photosynthesis are sugars; part of the sugar is used by the living cells of the leaf itself for respiration (see below), part of it travels from the leaf into the stem and thence to various parts of the plant where food is required for growth or storage, while the surplus is temporarily stored in the leaf in the form of insoluble starch; the accumulation of dissolved sugar in the sap of the leaf-cells would prevent the formation of more sugar, and the concentration of the solution would also injure the protoplasm. During photosynthesis, oxygen is set free, in volume equal to that of the carbon dioxide used up, according to the equation

$$6CO_2 + 6H_2O = C_6H_{12}O_6 + 6O_2.$$

The surplus of carbohydrate stored in the form of starch in the leaf during the daytime is at night converted into sugar, by the action of the ferment diastase, and the sugar passes to other parts of the plant. The roots, for instance, obtain their supplies of organic materials from the leaves, which in fact supply with elaborated food all parts of the plant which cannot, owing to the absence of chlorophyll, make such food for themselves, whether or

not they are exposed to the light and air, and which require organic food for life and growth, or which are storing up such food-growing points and cambium layers, storage organs like tubers, bulbs, ripening fruits and seeds, etc. For transport from one part of the plant to another, the food materials must be soluble in water and also diffusible (able to diffuse through cell-walls), hence starch must be converted into sugar, proteins into peptones, and so on; all organic substances which are more or less completely insoluble and indiffusible are changed by appropriate ferments into readily soluble and diffusible substances. On arriving at their destination these transported substances are either used up at once to supply the material and energy required for growth, or else stored up—usually after conversion into insoluble and indiffusible substances like starch, proteins, oils, and so forth.

Plants, like animals, respire—that is, they take in free oxygen from the air and give out carbon dioxide, losing carbon in the process. If a green plant is prevented from making food by photosynthesis, it simply lives on the organic food contained in its tissues, and eventually dies, losing in dry weight all the time. For instance, if we weigh two lots of dry bean seeds, soak both lots in water, and sow one lot (*a*) in the light and the other lot (*b*) in darkness, and let both lots of seedlings grow for some weeks, and then dry them thoroughly in an oven (after removing all soil from the roots if they have been germin-

ated in soil), we find that the dry weight will have increased in *a* and diminished in *b*; other differences will be seen—the seedlings grown in darkness will have small pale yellow leaves, while those grown in light have large normal green leaves. When a green plant respires, it simply consumes organic material which it had previously manufactured by photosynthesis; the equation representing respiration, so far as carbohydrates are concerned, is simply the reverse of that given above for photosynthesis, hence, roughly speaking, the two processes are antagonistic to each other. When sugar is formed from carbon dioxide and water, a certain amount of energy is fixed and oxygen is set free; afterwards, the sugar is, partly at any rate, consumed in respiration, oxygen being absorbed while carbon dioxide and water are produced and the fixed energy set free (in the form of heat, as can be shown with organs undergoing intense respiration, such as germinating seeds and opening buds and flowers). The plant is unable to make direct use of the sunlight falling upon it, but adopts this roundabout method, the use of which is obvious—if the plant were directly dependent on the sun's light for its supply of energy, it could only grow in the daytime, and even then the internal tissues could receive hardly any energy as compared with the tissues near or at the surface.

Having dealt briefly with photosynthesis (sometimes called "carbon assimilation") and respiration, we now

turn to a third process which is not, like these two, a vital process in the strict sense of the word, but is rather to be regarded as a "necessary evil"—transpiration. The salt solutions absorbed by the root from the soil are very dilute; for one thing, the solution must be dilute in order to pass rapidly (by the process of diffusion or osmosis) through the cell-walls. A certain amount of water is required to keep the cells saturated in order that they may fulfil their functions properly; the cell-walls must also be moist in order to absorb carbon dioxide and other gases efficiently. Some of the water is also used up in the process of photosynthesis, but after these requirements are met, the plant has to absorb an excessive amount of water in order to obtain the necessary quantities of the essential elements present in the salts dissolved in the solution absorbed from the soil. This excess of water is got rid of mainly as water-vapour, which is given off chiefly by the leaves. This escape of water-vapour is called transpiration, and the current of water which passes upwards from the root through the stem is the transpiration current. By simple experiments we can demonstrate the fact that leaves give off water-vapour, and can also measure the rate of the transpiration current, and prove that this varies with temperature, light intensity, humidity of the atmosphere, etc.

In order that the root may absorb sufficient water and dissolve salts, it must increase its surface of contact with

the soil in the most efficient and economical manner. When a seed is saturated with water and kept warm enough and given sufficient air (oxygen being essential) for germination to take place, the seed-coat is burst and the radicle of the embryo grows vertically downwards into the soil. This happens in whatever position the seed has been placed, and in order to grow downwards the root will overcome considerable resistance, for the downward growth of primary roots is a response to the "stimulus" of gravitation. The growing tip of the root is protected by a conical mass of tissue (root-cap) covering the growing-point; the outer tissue of the cap is continually worn away at the surface and renewed from within—just as in the case of the skin covering one's finger-tips. The growth in length of the root is confined to a short zone starting just behind the root-cap, and behind this zone—that is, in the young portion which has ceased to grow in length—there appear two kinds of outgrowths from the root. The epidermis cells grow out to form long thread-like root-hairs, which enormously increase the surface of the root and come into intimate contact with the soil-particles. Besides these hairs, the primary root bears secondary roots, or rootlets, which are arranged in regular longitudinal rows and which arise from the central vascular tissue of the parent root. The first branches borne by the vertical primary root grow out almost horizontally—in the French or runner bean, for instance,

there are four rows of these secondary roots, growing out in four directions at right angles. If we grow seedlings in a glass-sided box so that the direction of growth of the roots can be seen and marked on the outside of the glass, and then turn the box round into a slanting position, the growing tips of the primary and secondary roots will curve in such a way that the primary root once more grows vertically downwards, and those of the secondary roots take up their normal angle to the primary root; in both cases, therefore, the direction of growth is geotropic —that is, determined by a response to gravity. The secondary roots in turn bear root-hairs and also rootlets—the latter (tertiary roots) are not geotropic, however, but simply grow away at right angles from their parent root so that some may grow upwards instead of downwards or horizontally, hence the tertiary roots (and the later series of roots in the root-system) are termed exotropic.

The structure of the young root (fig. 3) differs from that of the young stem; the same tissue constituents are present, but their arrangement differs. Within the epidermis there is a zone of cortex, and in the centre is the vascular cylinder surrounded by a sheath consisting usually of two concentric layers of cells (the outer called endodermis, the inner pericycle) and consisting of wood, phloem, and ground tissue. The wood and phloem bundles are quite separate and alternate with each other in a ring, separated by ground tissue (conjunctive tissue) between

the bundles; the centre may be occupied by pith, or the wood bundles may extend to the centre and meet there, giving the wood a star-like appearance as seen in cross-section. The small, first-formed, spiral or annular vessels (protoxylem) in the root are at the outer side of the wood, the larger later-formed pitted vessels towards the centre—just the reverse of what is seen in the wood of the stem. The young root has no cambium, but later a layer of cambium is formed (partly from the conjunctive tissue on the inner side of the phloem bundles, partly from the pericycle on the outer side of the wood bundles), and secondary thickening then proceeds exactly as in the stem.

In the leaf (fig. 4), as in the stem, we have epidermis, ground tissue, and vascular bundles. The epidermis is a single layer of cells, covered with cuticle except at certain points where there are openings called stomates. The stomates are more abundant on the lower side of the leaf, in ordinary land-plants, and may even be confined to this side. Each stomate is formed in the young leaf by the splitting apart of two epidermis cells, so that a pore is left between these two guard-cells, which are curved and sausage-shaped and differ from the ordinary epidermis cells in containing chloroplasts. The guard-cells are able to become more strongly curved and thus widen the opening, or to become less curved and so narrow or nearly close the pore; these alterations in form of the guard-

cells, and the consequent widening or narrowing of the stomate, are dependent upon various factors, the most important being light—in fairly strong light the stomate opens widely, in darkness it becomes narrowed. The ground tissue (mesophyll) of the leaf is distinguished into two zones—an upper zone (palisade tissue) consisting of vertically elongated cells closely packed together so as to leave very narrow air-spaces between the cells, and a lower zone (spongy tissue) of star-shaped cells between which large air-spaces occur; in both kinds of cells there are abundant chloroplasts, especially in those of the palisade tissue. Each vascular bundle (vein) of the leaf consists of wood above and phloem below, without cambium; the veins are in the middle of the leaf between the palisade and spongy zones of the mesophyll.

The usual thin flat green foliage-leaf is obviously well adapted in structure for the functions which it performs. The stomates, which communicate with the system of air-spaces in the spongy mesophyll, serve for the various interchanges of gases between the plant and the air in the processes of photosynthesis (enter carbon dioxide, exit oxygen), respiration (enter oxygen, exit carbon dioxide), and transpiration (exit water-vapour). The branching veins support the thin web of green tissue and spread it out to the air and light; the cells of the upper epidermis, having more or less strongly curved walls, apparently act as lenses and concentrate the light on the underlying

green mesophyll; the upper palisade mesophyll is well adapted for catching light, the protoplasm of these cells moving and shifting the disc-like chloroplasts on to the vertical sides of the cell in too strong light or on to the horizontal upper and lower walls in weak light; while the spongy mesophyll is adapted for rapid passage of gases into and out of the leaf through the stomates.

Returning to the stem, there are some further points to be noted. The young parts of the stem have stomates in the epidermis, communicating with air-spaces in the green cortex, hence the stem can carry on a certain amount of photosynthesis and transpiration—though its primary functions are, obviously, to expose the leaves in the most efficient manner to the free air and light, to support the branches, flowers, and fruits as well as the leaves, to convey water from the root to the leaves and other parts of the shoot (along the wood vessels) and to carry leaf-manufactured organic food to other parts of the plant (along the sieve-tubes). As the stem grows in thickness, and therefore in circumference, a tangential strain is set up in the outer tissues, and if these tissues did not respond to this strain by growing and dividing they would be torn apart. The epidermis in some plants persists for a long time, but as a rule it is replaced, as the protective envelope, by a new tissue, the cork, which is produced by a special cambium layer (cork cambium) arising in most cases by growth and division of the

outermost layer of the cortex—that just within the epidermis. A few living cells are produced on the inner side of the cork-cambium, but most of the cells it forms are on the outer side and constitute the tough dead corky covering of old stems—the cork cells lose their protoplasm and their cell-walls become altered so as to be impermeable to water and gases. The living green cells of the cortex would thus be completely isolated from the air but for the fact that the cork is interrupted at places called lenticels (fig. 5), where, instead of compact impervious cork, the cork-cambium produces loose rounded cells which allow air to pass in and out, so that photosynthesis and transpiration are made possible even in the older cork-clad portions of the stem. The lenticels are easily seen as raised patches on the twigs of trees; in winter, however, the lenticels are blocked up, for in autumn the cork-cambium produces compact instead of loose lenticel-tissue, this layer of compact tissue being, however, broken again in the following spring.

It is important to note that tissue which has become permanent, that is, has ceased to grow and divide, may under certain conditions awake, so to speak, into activity and undergo growth and division so as to produce new tissue, in order to meet the requirements of the plant. Examples of this are seen in the completion of the cambium layer in the stem by means of the ray tissue between the bundles of the young stem; in the origin of

the cambium of the root; in that of the cork-cambium in stem and root; and in the formation of the absciss layer of corky tissue formed across the base of the leaf in autumn, this layer afterwards splitting in such a way that the leaf is detached and falls, while a film of cork is left on the stem as the leaf-scar. An interesting case is seen in the formation of callus over wounded surfaces, whether due to accident (as when a branch breaks off close to the trunk) or to design, as when a forester or gardener saws off the limb of a tree. The cambium, which has been exposed, produces a mass of growing tissue, called callus, which in time rolls over and covers the wounded surface of the wood—for the wood cannot heal of itself. If the wound is a small one, the callus soon reaches the centre and forms a continuous tissue which produces cork on the free surface and then behaves like the ordinary cambium, producing wood internally over the stump. The callus protects the exposed wood by excluding water, bacteria, and fungus-spores which would set up decay and might destroy the tree; if the stump left after breaking off a branch is too long, the cambium cannot produce enough callus to cover and protect it, hence it is important that the stump should he promptly sawn off close to the trunk. A clean-cut smooth surface at right angles to the branch is desirable, since it affords less footing for water and germs, avoids undue crushing and tearing of the cambium, and is more readily healed over by callus. In

the case of a large wound, the surface should be protected by applying tar or lead-paint—this does not hasten the growth of the callus, which may take several years to grow over it, but it protects the open portion of the wound from moisture and germs. Wounds made in herbaceous stems, roots, tubers, leaves, etc., are healed in a simpler manner; in general, whenever the inner tissues are laid bare by injury a layer of cork is formed by the exposed cells, and roots protrude from the callus (fig. 6).

Not only may "dormant" cells in the stem and root awake into activity under special conditions, but entire dormant shoots (that is, buds) may, by some change in the equilibrium of the plant, become active and grow out, even after remaining in the dormant state for a prolonged period. If, for instance, we allow a Broad Bean seedling to germinate until the young shoot (plumule) has reached a height of a few inches, and then cut the stem off below the lowest foliage-leaves, the buds in the axils of the cotyledons will grow up as two new shoots. Here we have a simple case of pruning, though of course exactly the same thing may happen naturally should the growth of the plumule be arrested or destroyed from any cause. The plumule, like the radicle, grows at the expense of the food (starch and proteins) stored in the cotyledons, and when the plumule, which had been draining the food-supply as rapidly as the latter was made transportable by conversion into soluble and diffusible substances, is

removed, the buds at its base receive this stream of food and at once grow out and replace the lost plumule. The simplest case of pruning, as seen for instance in the clipping of a privet hedge, has for its object the awakening to activity of resting buds, which might otherwise remain dormant or eventually die.

Pruning, especially as applied to fruit trees, is an art which requires great skill, for it is necessary to know whether one is pruning (1) for increased wood-production, (2) to induce and increase fruit-bearing, (3) to train and restrict the tree to any desired shape and size, (4) to remove injured or decaying or superfluous parts, or (5) to ensure larger or better fruits. One of the chief points to bear in mind is that all parts of a tree should receive plenty of light and air, because the formation of flower-buds (and therefore of fruits) depends largely upon the efficiency of the leaves. The flower-buds on a shoot are in most cases easily recognised long before they open, by being larger and more rounded than the vegetative buds ("leaf-buds"); for instance, in Apple, Pear, Plum, and Cherry they are on "spurs" (short and slow-growing branches or dwarf-shoots) on the twigs of the previous year or years, and mostly at the ends of the spurs. In large-fruited trees each spur tends to fruit only in alternate years, because the ordinary food-supply is insufficient to nourish the fruit and a new fruit-bud, which is not usually formed until the following year and

which fruits in the year after its formation. The removal of the flowers or very young fruits from part of the spurs of a tree, or from certain branches, encourages the fruiting of the pruned parts the following year, and so tends to set up an annual fruiting habit, some portion of the spurs and branches fruiting while the remainder are forming fruit-buds which will bear the following year. Trees which for any cause do not come into "bearing" can often be induced to form fruit-buds by judicious pruning. The checking of growth induces fruitfulness, but does not maintain it; and when once bearing is established it must be preserved by proper care and the avoidance of any disturbing element, such as heavy pruning or the bearing of too heavy a crop. The younger a shoot, the more rapidly and completely it heals, hence shoots which are to be removed should be pruned as young as possible. The healing process cannot take place in late autumn or winter, as the cambium is then dormant, hence the best season for pruning woody parts of trees is immediately before growth begins in spring, and while the tree is still dormant—the more rapidly a wound heals, the less is the chance of decay getting a foothold. Pruning is sometimes done in autumn, before the leaves have fallen, because the presence of the leaves enables one to judge upon the density of the branches and foliage. Trees which bear their fruit on short spurs often produce a large number of useless shoots, and if these are retained until the autumn

much valuable time is lost to the tree. Sunlight is prevented from reaching the leaves in whose axils the fruit-buds are being formed, and this may seriously affect their development. By a timely removal of superfluous growth more fruit-buds are also produced, hence the importance of summer pruning is seen in such cases.

The effects of pruning in hastening or increasing fruit-production are sometimes augmented in practice by bending or twisting the shoots, by notching, and by ringing. Bending a shoot horizontally results in the supply of water being diminished along its entire length, as the bend retards the flow—a sharp bend in a branch acts as a partial barrier to the upward flow of sap and to the descent of elaborated food, the latter accumulating above the bend and causing the development of fruit-buds. Twisting a shoot is a more energetic means of effecting the same result. Notching is used to force the development of particular buds, the notch being made in the bark and young wood immediately above the selected bud. The notch checks the upward flow of sap, and so induces elongation of the bud into a shoot. Notching into the wood below a bud stops the downward passage of elaborated food, the store so formed encouraging the formation of fruit-buds. The size of the notch varies with that of the branch, a narrow notch being ample for small shoots while half an inch is not too much for a large branch. Ringing is effected by cutting through the

bark completely round the stem, to keep the elaborated food from descending below the ring; this results in inducing bearing and in hastening the production of larger fruits.

Grafting consists in placing together the cut surfaces of two different plants, belonging to the same family (*e.g.* Rosaceæ), in such a way that they unite by the growing together of their cambium tissues; the rooted plant, which is to receive the graft, is called the stock, while the cutting which is applied to the stock, and which consists of a twig bearing buds, is called the scion. Naturally, success in grafting depends largely on the work being done when growth is vigorous and injuries readily repaired, and upon the health and vigour of both scion and stock; the wounds made in grafting are covered with wax to exclude disease germs and to prevent evaporation or loss of sap from the wounded tissues. The scions are usually cut in autumn from wood of the previous year's growth, with well-developed buds, and stored in damp sand or soil to prevent withering; the scion may be inserted in the root, trunk, crown, or branches of the stock, and there is a great variety in the methods of grafting, differing in the manner in which the scion is applied to the stock.

Budding consists in taking a single bud from the tree which it is desired to propagate, together with a portion of the outer tissue (including the cambium), and placing

it in contact with the cambium of the tree which is to serve as the stock. It is generally performed in early summer or early autumn; or in early spring with resting-buds taken in autumn or winter, and kept with their ends set in soil (as with scions for grafting). The piece of young wood, with the bud, is inserted below the outer tissue of the stock, and securely tied in position (the tying strings being removed later to avoid ill-effects due to constriction); union is effected between the cambium at the base of the inserted bud and that of the stock.

Propagation by cuttings involves various physiological processes, according to whether the part used is stem, root, or leaf. In the ordinary method, the cutting is simply a piece of shoot, which is stuck in the soil and "strikes root"—most woody plants and many herbaceous ones are readily propagated in this way. In propagation by stem-cuttings the objects aimed at are to induce the rapid healing of the cut surface by the formation of callus, and to induce the formation of adventitious roots, thus enabling the cutting to become an independent plant. In herbaceous cuttings the stem contains very little reserve food, and the cortex and pith tissues co-operate with the cambium in the formation of the callus; in woody plants, enough food is stored in the stem-tissues (cortex, phloem, rays, wood parenchyma), the cells of which, on absorbing water, grow and divide to form a mass

of growing tissue, driving off the wounded and dead cells at the surface as a cork-layer, while the inner callus-cells form a cambium (continuous with the ordinary cambium of the stem) which produces new wood and phloem as well as roots. The cuttings of soft-wooded plants require a higher temperature and more moist atmosphere than that in which they grow when established, in order to induce rapid growth and formation of roots and at the same time to prevent undue transpiration; the cuttings should also be shaded, to minimise transpiration, though light is required in order that photosynthesis may be carried on and thus supply additional food to the new roots. It is best to make the cut just below a node, since roots spring more readily from the nodes than from other parts of the stem; since various fruit trees and shrubs are liable to produce suckers (underground shoots), it is better to remove the buds from the lower end of the cutting before placing it in the soil.

Isolated pieces of stem, root, or leaf may give rise to new plants, producing new roots and shoots. When a piece of stem is placed below the soil, it is noticeable that the roots arise chiefly from that end which was nearest the root in the intact stem, and the shoots from the opposite end —that is to say, a fragment of stem has a more or less decided "polarity." The same is the case with the roots of some plants (*e.g.* Pelargoniums, Hawthorns) which can be used as cuttings; while in some plants (*e.g.* Begonias

and Gloxinias) roots and buds are produced when entire leaves, or pieces of leaf, are detached and placed on damp soil. From experiments with "cuttings" of various kinds, it is inferred that practically any part of the plant which contains living tissue is potentially capable of regenerating an entire plant, when the right conditions are provided.

PROPAGATION

In nature the great majority of plants reproduce themselves readily from seed, but in many cases this is a slow process and does not appeal to the gardener or nurseryman, whose work it is to raise and bring plants to maturity in the shortest possible period of time. In addition to the more general method of reproduction by seeds, plants may also be reproduced by cuttings or slips procured from the stem, roots, or leaves, by layering, offsets, suckers, runners, tubers, and corms or bulbs, while budding and grafting afford special facilities for the rapid propagation of some plants, cuttings from which do not strike readily, or where, as in the case of fruit trees, a plant is strengthened by establishing it on the roots of a stronger growing species. Whatever the method of propagation adopted, a considerable amount of practical experience is necessary before success can be ensured; nevertheless a few general observations will doubtless prove helpful to the beginner.

Seeds.—Seeds, in order to germinate freely, must be supplied with heat, air, and moisture, otherwise the embryo will remain inactive, or, if germination does

commence, death will quickly ensue. Plants reproduce their species more or less true from seeds, provided foreign pollen has not been introduced during fertilisation, while, on the other hand, the substitution of pollen from plants capable of effecting fertility results in the raising of numerous new varieties, as instanced by the great increase in the variety of florist flowers by cross fertilisation during recent years. The raising of many plants from seed in preference to other methods of propagation has often a beneficial effect in imparting renewed strength of constitution, as so well exemplified in the case of potatoes, which if constantly propagated from tubers soon become constitutionally weaker. Annual plants provide another example of the necessity for propagation from seed, as the plant dies immediately after the seed comes to maturity. The season of ripening and the method of harvesting have much to do with the quality of seeds, while selection is another point to which seedsmen pay special attention, and one which has a distinct bearing in regulating the cost of any particular species or variety in commerce. However good the seed, it must be properly preserved and stored during the interval between collecting and sowing, otherwise its germinative properties will become seriously impaired. This is particularly noticeable when sowing tropical seeds received from various parts of the world, as many of these, owing to imperfect packing and the excess of moisture they contain, readily lose their

vitality; but apart from these reasons, it can generally be assumed that oily seeds lose their vitality much quicker than do seeds containing a large percentage of carbon. The seeds of many of our forest trees and shrubs quickly lose their germinative properties if kept in a dry atmosphere, and it is for this reason that they are placed in sand or slightly damp soil until the proper season of sowing arrives. Some seeds improve by keeping for several years, and this is particularly noticeable in the case of many of those of the Gourd family, which certainly produce better plants when kept for several years than is the case when they are sown immediately after maturing; on the other hand, the seeds of Lapageria and others of similar composition are best sown while quite fresh. Exceptional longevity is attributed to the seeds of Zea Mais, which are largely imported for the manufacture of arrowroot, and to many others. It may be interesting to note that out of 400 species, representing 74 natural orders, 95 kinds grew after 3 years, 57 from 4 to 8 years, 16 from 8 to 20 years, 5 from 25 to 27 years, and 3 after 40 years. It is not wise, however, to make a practice of sowing old seeds for reproductive purposes, even though they be capable of germination, as the rapidity with which seeds germinate is an important factor in denoting their constitutional strength, and while the seeds of asparagus, for example, may germinate freely between 4 and 8 years of age, carrots from 5 to 10 years,

cucumbers 8 to 10 years, peas 2 to 7 years, and tomatoes 3 to 6 years, it is nevertheless advisable to sow seeds of not more than 2 years, or at the most 3 years of age.

Where a large number of seeds are to be sown under glass it is always advisable to stand the pans or boxes containing them in a slightly heated hot-bed, and shade from strong light and excessive sun-heat by means of tiffany or canvas stretched over a thin wooden frame, which if kept repeatedly moistened will obviate the necessity of continually watering the seeds, as this, in the case of those of slow germination, proves highly detrimental to the health of the young plants through the production of an acid condition of the soil. Some seeds, as in the case of many varieties of palms, and, as an extreme example, in the case of Nelumbium or Sacred Lily of the Nile, and many other hard-coated seeds, may not germinate under two years, and thus it is evident that during that period the soil surrounding the seed must be given periodical attention to prevent stagnation. With slowly germinating seeds, devices such as filing the hard outer coat of the seed, long continuous soaking, or stratifying, are among some of the methods adopted to hasten germination. Seeds which have a hard bony testa, such as in Cratægus and many other species of Rosaceæ, are often mixed with soil and buried in the ground for twelve months or so before sowing, by which germination is greatly accelerated, while the action of

frost on autumn-sown seeds often hastens germination in spring.

Whatever the nature or variety of seed sown, the time of sowing must be regulated so that the young plants appear at the season most suitable for their growth. For example, tender annuals must be sown in the spring, while some of the hardier ones will survive the winter and so produce better plants through the gain in time and increased hardiness of constitution. The seeds of biennial plants, that is those which do not flower until the second year, require sowing about midsummer in order that they may be afforded an opportunity of becoming well established before winter. The seeds of Alpine and herbaceous plants are best sown during late autumn or early spring in pans filled with a sweet open compost of loam, peat, and sand, or, for bog plants, chopped sphagnum and peat, and placed in cool frames, where even under a covering of snow many of the Alpines will germinate freely. The gardener who is called upon to supply a succession of flowers or vegetables must of necessity make a number of experimental sowings, as it not infrequently happens that a particular season may favour the growth of plants sown exceptionally early or late, as the case may be.

Seeds are usually sown at a depth equal to their diameter. Very fine seeds, such as those of Orchids, are best sown upon the surface of the pots or baskets in which established plants are growing, a method of which

Cattleyas provide a familiar example. Chopped sphagnum moss provides just the condition required for the successful germination and healthy development of Tillandsias, Nepenthes, Sarracenias, etc. Knowing the character of the plant, the quality of the seeds sown will to some extent determine the quantity to be relegated to a given area, and this can usually be ascertained by external appearances, such as clearness of skin, plumpness, colour, odour, etc., while with many the specific gravity will be indicated according as they swim or sink when placed in water. When there is actual doubt as to the germinative power of any sample of seed from which it is desired to secure a high percentage of seedlings, a simple test should be made by placing ten or any given number of seeds between two pads of moistened blotting-paper and subjecting them to the necessary temperature, when later it will be an easy matter to arrive at the germinating capacity.

When sown in the open ground the seeds are either broad-casted, scattered indiscriminately, or confined to drills at regular distances apart. The latter method of sowing is the most usual, as it affords an opportunity of keeping the ground clean and thinning out the seedlings where desired. When sowing under glass, shallow pans or boxes are undoubtedly preferable to pots, as in the case of small seeds very little depth of soil is required to insure germination. There are, of course, a few

exceptions, and notably in the case of palms, the roots of which make a strong downward growth. With very large seeds, on the other hand, of which the cocoanut may be taken as an extreme example, sowings are best made in a bed of cocoanut fibre. With regard to the compost for seedlings, this should be rather light, yet firm or consolidated, and entirely free from manure or plant food that is likely to unduly excite or injure the growth of the seedling. It is usually found that the shallower the seeds are sown within reason, the better developed and stronger are the seedlings, but in order still further to assist their development the seedlings should be carefully pricked out into pans or boxes of specially prepared soil as soon as they can be conveniently handled. On the other hand, should they appear crowded a second thinning is advisable. All seedlings raised in excessive heat must be gradually hardened off before any attempt at transplanting is made. Fatal results often occur from watering delicate seedlings overhead, therefore it is preferable to plunge the pans in water so that the moisture reaches the seed from below. Fine seeds, such as Begonias, Gloxinias, Streptocarpus, etc., are best sown in shallow pans and covered with green or smoked glass. They should then be placed on shelves where they can receive a moderate amount of air and light, until the seedlings become hardened. If success is to attend the raising of plants from seedlings, anything that tends to

check the growth of the seedling will inevitably produce bad results later, so that the greatest care is necessary in the earlier stages of the plant's growth. When transplanting seedlings the roots should always be allowed to *go straight down and never cramped or turned upwards* as shown in fig. 7.

CUTTINGS.—Many flowering plants, trees, and shrubs may be *propagated by means of cuttings or slips of matured* or partially matured wood, while in some instances—as in the case of the vine—it is only necessary to insert buds or eyes with a heel of wood attached (fig. 8) in order to secure strong, healthy plants. The principal advantage of multiplying plants from cuttings is that a fully developed and often a stronger plant is obtained in considerably less time than when seed is sown, while the character of the plant is usually preserved. There is great variation in the conditions required to ensure success by this means of reproduction. For example, plants of a semi-aquatic character will root readily when placed in a moisture-laden soil, while if we go to the other extreme, cuttings of cactaceous plants root freely when placed in dry sand and exposed to the burning rays of the sun; some species of Cacti produce bulbules from the spine-cushions and also on the axis, all of which soon become established plants.

When inserting cuttings of many species and varieties of hard-wooded plants, even the most skilled of propagators

will encounter disappointments, as success is dependent upon so many conditions, chief among which are the season when the cuttings are selected and the condition of the wood as regards ripeness and age. Cuttings of most soft-wooded plants require a higher temperature and a much closer atmosphere than that to which the parent plants have been accustomed, the reason of this being that a close and moist atmosphere prevents excessive transpiration, while increased warmth tends to encourage root action. Cuttings of young wood do not make much callus, while woody cuttings usually do to the extent that their tissues harden and prevent roots from penetrating, with the result that the callus requires pricking or partial removal with a knife, and the cuttings subjected to increased heat before an adequate supply of roots can be formed. Reasonable ventilation is necessary where cuttings show a tendency to "damp off." Many exotics, composed of firm wood and of active growth, taking as they do longer for their roots to form, require more ventilation, while increased heat would have little effect in increasing root action. It is usual, as in the case of raising seeds, to stand or plunge pots containing cuttings in a hot-bed composed of cocoanut fibre overlying whatever form of heat is adopted. Exception to this is made, however, in the case of hard-wooded cuttings which do not generally require bottom heat, and of course in the case of tropical species such as Codiæum, Ixora, Allamander, etc.

Cuttings of Dracæna, Pandanus, Oleander, and similar plants, root freely when placed in water, after which they may be potted in the ordinary way. Cuttings of ornamental fruiting and berry-bearing plants as Rivina, Solanum, Callicarpa, Capsicum, and Psychotria, are best put in early in order that they may flower early in summer and so ripen their fruit by autumn. Coniferi and hardy deciduous trees and shrubs are very largely propagated from cuttings, when in the majority of cases the terminal shoots of the branches are selected during early autumn, at which season the sap is less active and therefore the growths are soft. They are best placed under hand lights or frames, which treatment answers equally well for such plants as Deutzia, Spiræa, Ribes, Philadelphus, etc. If desired, however, large shoots of several years' growth of many deciduous flowering shrubs will root in the open ground during autumn.

Although failures may be frequent, one should never despair, as after repeated failures it is not uncommon to find a whole batch of cuttings root freely without any apparent cause, unless it be a difference in the ripeness of the wood, seeing that previous batches treated in exactly the same way may have failed altogether, or merely formed a callus from which no roots protruded. When selecting cuttings never take them from other than healthy plants, and always avoid those that are coarse and sappy, as they invariably "damp off." An instance of this is afforded

in the case of Geraniums, gross sappy cuttings from which are always difficult to strike, unless they are allowed to dry thoroughly before insertion in the soil, and afterwards kept almost without water until a callus has formed. On the other hand, a well-matured, short-jointed cutting from a plant grown in an exposed position, as shown in fig. 9, may be placed immediately in the soil and watered, when in the course of several weeks roots will be freely emitted.

As it is preferable to strike soft-wooded cuttings in the spring, the old plants, many of which are cut back hard in the autumn, are started in gentle heat, and when the young shoots have attained a length of several inches, they are removed with a portion or heel of the old wood attached (fig. 10). The common Fuchsia may be cited as an example of a plant propagated in this manner.

Geraniums, on the other hand, may be freely propagated in the autumn, in which case strong stocky plants are produced by summer, whereas if inserted in spring a considerably less robust plant is obtained, and therefore less suitable for bedding, or other purposes.

In preparing cuttings a sharp knife must be used, otherwise the delicate tissues of the stem may be bruised and so facilitate decay. The lower leaves, petioles, and any fleshy bracts attached near the base of the cutting and in such a position as to entail their being placed under the soil, must be carefully removed, as, in decaying, they may cause a rotting of the stem. When preparing

cuttings careful propagators never cut through the internodes of the stem, but always immediately under a joint or node, as here the tissue of which the stem is composed is more compressed and less likely to decay than is that composing the more elongated portion. Some cuttings, as for example Carnation, root more freely when split longitudinally to a length of half an inch or so, thus exposing a larger surface from which roots are emitted. When cuttings of bush fruits and hardy deciduous shrubs are placed in the open, care must be taken that they are inserted sufficiently early to enable them to obtain the benefit of a warm soil temperature before winter, otherwise there is little to encourage root action in spring, and in the meantime the percentage of losses will be great.

The propagation of plants from matured leaves is often practised in the case of Gloxinia, Streptocarpus, Begonia, and many other gesneraceous plants. No better example is afforded than that of Begonia Rex (fig. 11), where, if a large fully-matured leaf, the mid-ribs of which have first been severed with a knife, be placed on a bed of cocoanut fibre or other moist porous compost and pegged in position, it will in the course of a few days give rise to a number of small plants wherever the cut surfaces come in contact with the soil, the strongest plants being formed from the stoutest mid-ribs. In propagating *Ficus elastica* the leaf treated is not a "cutting" to the same extent, inasmuch as the soft joint

containing a bud in the axil of the leaf is inserted in the soil, the leaf serving to elaborate sap and being held in position by a skewer or stake passed through it into the soil (fig 12). In addition to Begonias, many other plants, such as Peperomia, Ramondia, Pyrenaica, Bertolonia, Echeveria, Phyllogathis, etc., can be reproduced from leaves. It is important to remember that where growth is continuous, as in the case of spring-struck cuttings, the retention of a healthy and fresh condition of the foliage is essential, as, should it become destroyed through any cause, nothing remains to carry on the manufacture of material necessary for plant growth, and in consequence death ensues.

Cuttings of the root as a means of propagation are rarely resorted to, except in the case of Sea-kale and Horse-radish, and flowering plants such as Bouvardia, Rhus, Calycanthus, Paulownia, Pelargonium, Sophora, etc. The roots are cut in sections varying in length from one to six inches, and inserted in boxes of soil, when, if subjected to gentle bottom heat, new roots readily protrude from the older root. Meanwhile leaf-buds are formed on the surface of the cutting exposed (fig. 13). The Apple, Pear, Plum, Quince, Whitethorn, Elm, Poplar, Rose, and various other trees may be multiplied by root cuttings, but the practice for many reasons is but rarely adopted.

LAYERING.—Layering is largely practised in the case of

those plants which are difficult to strike from cuttings, and consists in bending a branch or shoot in such a way that it is made to come in contact with the soil, at which juncture it is partially severed by means of a cut or ligature, which results in the emission of roots (fig. 14). The object of not severing the plant altogether is that the portion to be removed, and which would be difficult, if not impossible, to strike in the ordinary way, will then receive that amount of nourishment necessary to keep it healthy, and to enable the foliage to elaborate sap until a sufficiency of roots is developed, when finally it can be severed from the parent plant.

Species and varieties of Aucuba, Laurel, Rhododendron, Vine, Clematis, and Carnation, are all examples of plants the propagation of which cannot be readily effected by means of cuttings, and therefore one or other of the numerous modifications of layering has to be resorted to, such as tonguing, twisting, wiring, ringing, etc. Mere contact with the soil is sufficient to induce many plants to emit roots at the point of contact. Usually, however, a tongue or heel is made in the stem in an upward direction, the surfaces being kept apart by means of a small piece of stone to prevent them closing and healing, and to allow a greater number of roots to be emitted. In layering it is necessary to remove from the shoot those buds not required to form stems or branches, after which the layer is pegged firmly in position and covered with soil; while, should the portion

protruding from the soil be sufficiently long to necessitate staking, this must be done, as any undue rocking to and fro by the wind would greatly interfere with the formation of roots.

Twisting or piercing of the stem is often resorted to where ordinary methods of layering fail. For example, the twisting of the stems of many varieties of apples, particularly those of the Codlin type, by rending the sap vessels, will induce the formation of roots in a much shorter space of time than is possible when the stems are merely notched. Plants possessing hard or brittle wood, or even soft wood that is subject to bruising, cannot be satisfactorily treated in this manner, but there are many hard-wooded shrubs and trees the wood of which readily admits of being twisted in early autumn.

Wiring, or what is often only strangulation, is frequently practised in the case of many hard-wooded plants which are difficult to propagate by other forms of layering. A piece of wire is strained tightly round the stem so as to check the downward flow of sap, with the result that a large accumulation of woody tissue is formed from which roots are very freely emitted, provided that this thickened band is pierced here and there with a sharp instrument and afterwards kept covered with damp sphagnum moss or imbedded in the soil.

Ringing, or the removal of a circular band of bark, is preferable to wiring, and, with but few exceptions, will

produce equally satisfactory results. The physiological conditions are practically identical, inasmuch as the downward flow of sap is checked and a soft callus formed, from which roots readily protrude.

What is known as serpentine layering is practised in the case of many plants with long, procumbent, or climbing stems such as Lapagerias. The stems are made to dip down at intervals into the soil, each lower curve being tongued and held in position by means of a peg. When rooted, the sections which are then individual plants are severed and potted, the bud in the axils of the leaves increasing in proportion to the strength of the root.

A method of layering generally adopted by nurserymen in the propagation of gooseberries, currants, quince, paradise, and many other varieties of stocks for grafting, is by encouraging as far as possible basal or even sucker growth. The numerous shoots so produced are notched close to the surface of the ground, while the centre of the bush is filled up with soil throughout autumn and winter, which latter practice characterises the special method of layering known as mound layering. In the spring or following autumn the plants are carefully removed to the nursery rows. A good illustration of propagation by means of suckers is afforded in the case of the raspberry, a plant almost wholly increased by this method; no artificial mutilation or distortion of the sucker is necessary, as it becomes naturally clothed with an abundance of fibrous roots. In fact, the weaker

the sucker, the more fibrous the roots. Plums and many other fruits, also roses, throw up suckers in profusion, from the stocks upon which they are grafted, and especially so when the growth of the scion for some reason or other becomes checked.

GRAFTING.—Propagation by grafting is one of the most important methods of multiplying plants, and among its chief advantages are the following:—(1) To save time. Where, for example, in the case of many fruits, one would have to wait ten or even more years before obtaining fruit, by grafting it can be secured in from two to three years. (2) To make use of the age and strength of a cheap, easily obtainable, or exceptionally vigorous, stock, in order to obtain quickly the fruits produced by the plant from which the scions are cut. (3) To alter the habit of the plant, that is, by dwarfing. This is well demonstrated in the case of Pears grafted on the Quince and Apples grafted on the Paradise stocks, while there are also many striking examples among our ornamental flowering plants and shrubs. (4) To propagate plants which do not seed freely or are difficult to strike from cuttings, and to keep sorts free and true to type. (5) To improve the flavour and colour of fruit, while it is well known that in the case of hardy fruits many stocks influence the season of ripening. (6) To enable plants to grow on soils, and in climates, which under ordinary circumstances would be unsuitable for them. For example, some varieties of Peaches succeed

very well on heavy soils if grafted on Plum stocks, and *vice versâ* where Plums are found to survive on lighter soils, whereas when grown on Plum stocks they prove barren and gradually die. Similarly Pears intended for very light soils are often grafted on the Mountain Ash, and we know that the Apple may be grafted on any of the many species of Willow. All these are, however, extreme cases, and do not commend themselves to the commercial or practical grower, but much can undoubtedly be done in the way of experimenting on these lines. (7) To grow several kinds on one plant—a practice, however, not to be encouraged. (8) To correct imperfect habits of growth and to renovate wall trees. (9) To renew the fertility of old trees.

Science has not yet been able to determine what affinities cause stock and scion of different genera and species of plants to unite, and thus propagators may be regarded as experimenters in the truest sense of the word. During recent years too much has probably been written with regard to grafting as a means of propagation; many amateurs exploit their efficiency, while children, particularly in rural schools, are engaged in grafting and budding often without any definite aim in view. Although the operation has certainly some advantages, these are very easily over-estimated, as practical experience goes to show that the longevity of the large majority of plants is greater when they are established on their own roots; and it is for this

reason that root-grafting is often advocated, in order that the plants may be given an opportunity of sending out roots from the scion, by which process healthier plants are in some instances obtained. These remarks do not of course apply where strong-growing stocks like the Pear, Crab, or Briar are used.

As a general rule, plants possessing very similar physiological characteristics unite freely, mere relation with regard to genera or species often serving as little guide to the experimenter. While no difficulty may present itself in securing a union, the result so produced is often anything but satisfactory from a commercial or practical standpoint, and is often a disfigurement to the tree. This is sometimes seen in the case of the Peach, where the stem of the scion is altogether out of proportion to that of the stock, the latter having remained diminutive. Attempts are often made to encourage growth by lacerating the bark, a practice which, apart from being unsightly, has very little beneficial effect.

As previously explained, the operation of grafting necessitates the bringing of the cambium layers of the scion in contact with those of the stock. This, of course, cannot be so readily effected when the two possess considerable variation in size, and thus it is necessary to adopt such means as will ensure an effective union; and so different methods of grafting have to be devised, each possessing distinctive merits. To ensure successful results the con-

dition of both stock and scion will require careful consideration. In the first place, the stock should be dormant to a great extent, or just becoming active, when the scion is inserted, and to obtain this condition it is often advisable to head back large trees intended for crown-grafting early in the year before the sap is expended in the branches (figs. 15 and 16). This drastic treatment may of course have the effect of producing numerous suckers, unless several buds or branches can be retained, but usually it is found that the scion will make excessive growth and so put any excess of vitality to good use. Disappointment often attends the grafting of young transplanted stocks, the roots of which have not had time to become established, and thus no advantage is obtained by grafting too early. Another point to be borne in mind is that the buds of the scion should be dormant and the growth never in advance of that of the stock. It is for this reason that in the great majority of cases it becomes necessary to remove scions intended for grafting during winter and to place them in a cool shady position, or bury them in the ground, until the season for grafting arrives, which for the great majority of plants in the open is during the month of March. Examples of forward buds are to be seen in the case of Pears (fig. 17), and it is evident that if these be inserted in the stock during March they will all become exhausted and the scion shrivelled long before

an effective union, necessary to stimulate the buds, can take place.

After the scion and stock have been placed in position it is necessary to tie them together with some suitable material, usually bast or worsted, and cover the whole with a suitable grafting wax to exclude the air, which would prove very detrimental through its drying effects. In the case of root-grafting, waxing or even tying is not often necessary, a sufficient covering of soil being all that is needed for protection from injury, while the natural moisture of the soil prevents any undue evaporation. The kind of plant under consideration will afford the operator some idea of the best form of grafting to adopt. There is practically no limit to the methods practised, but for general purposes whip grafting is the most desirable.

Whip or tongue grafting (fig. 18) is largely employed in the grafting of hardy fruits. When the stock and scion are of equal diameter a perfect union takes place, but where the scion is smaller than the stock care must be taken to see that at least one side of the cambium layer of the scion coincides with that of the stock; if merely placed against the wood of the stock no union would be effected. The advantage of a tongue to the scion is that when placed in a corresponding cleft in the stock it helps to keep the two in position.

Notch grafting is one of the simplest and most effective means of grafting where the stock is no more

than from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in diameter and the scion varies up to, say, $\frac{1}{4}$ of an inch. A notch-like incision is made in the stock, while the scion is shaped after the manner of the portion removed from the stock, into which it is then fitted.

In saddle-grafting (fig. 19) the stock and scion should be of as nearly as possible equal diameters. The stock is cut in the form of a wedge, while the scion is merely split and a little of the wood removed from either side of the base in order to enable it to rest like a saddle on the prepared stock, and to bring the whole of the exposed cambium layers into contact. This method of grafting is largely employed where the scions are weak or of an herbaceous character.

Splice-grafting, which is the simplest form of grafting, is usually applied to soft- or tender-wooded plants and where stock and scion are of equal diameter. The surfaces are cut with a long diagonal slant, when, if of equal area, a perfect union takes place. Needless to say, this method is only practised in the case of small stocks.

By side-grafting is meant the insertion of the scion into the side of the stock without heading back the latter. An incision about one inch in length is made through the bark of the stock by means of a fine sharp chisel. The scion is cut wedge-shape and is then pressed home until its cut surface is concealed under the bark; or it may be performed as shown in fig. 20.

Inarching is another form of grafting in which the scion is only partly severed, and is dependent upon the parent plant until a union has been effected.

The cutting down and grafting of old orchard trees is not to be generally advocated, as, although the scion makes a strong, rapid growth and comes into bearing at a comparatively early age, it not infrequently happens that a reaction sets in when the branches increase in size and demand greater vigour from the stock. While it may be argued that the growth of the scion stimulates or invigorates the formation of new roots, my experience has been that the re-establishment of roots in contact with dry worn-out soil and in the vicinity of the older decayed roots, ends in the ultimate collapse and decay of the whole tree in from five to seven years after grafting. Heading back young standard or even ten-year-old trees of a worthless variety, and inserting young scions of a more suitable sort, is entirely a different matter, as the trees are only just beginning to establish themselves.

Budding.—Budding, or bud-grafting (fig. 21), is often regarded as an altogether different process from ordinary grafting, but in reality it is almost identical, except that a dormant bud with a small portion of wood attached is used during summer, throughout the months of July and August, in place of inserting a woody branch in spring. The operation probably calls for more dexterity than grafting in the ordinary way, and a little practice is

necessary before efficiency is attained. In all methods of grafting a sharp knife is essential, and particularly so in the removal and preparation of buds, as care must be taken not to unduly damage the delicate inner bark. Usually the bud is inserted under the bark of the stock as in shield-budding, while in flute-budding the bud and portion of bark removed cover as nearly as possible the same area as the bark removed on the stock for its reception. Buds should always be inserted when the circulation or flow of sap becomes less active, as, should sap be flowing freely, the bud is often displaced, or, should union take place, the bud will be stimulated into active growth instead of remaining dormant until the following spring. In any case, success is best achieved when the bark separates readily from the wood, a condition which is most essential in the case of flute-budding.

There are no hard and fast rules as to whether preference should be given to budding or grafting; in fact, budding is often performed after grafting has failed, and *vice versâ*. Usually, however, stoned fruits are budded, as they are then less liable to gumming, particularly when they have attained some considerable size. The younger the stock within reason the more easily budding can be performed, and with the majority of fruit trees a most convenient size is when the seedlings are about two years of age, and in the summer following their removal into nursery rows. Before transplanting, the seedlings should

be carefully trimmed, the tap-root cut back, and the stem shortened to one-third or so of its original length. A week or so previous to budding the seedlings should be gone over, and any buds in the vicinity of that portion of the stem on which the operation is to take place should be rubbed off, or, if any small branches be formed, these should be cut off level with the stem. The closer the bud can be inserted to the root the better, as, if under the ground-line, the union will not show when the plant is transplanted into its permanent quarters. Whenever possible, buds should be inserted on the north side of the stock, as in this position they are kept more moist. After tying the bud in position it may be necessary still further to shorten back those shoots which are making too luxuriant a growth, thus depriving the bud of nutrition. At the same time the removal of too much upper growth will have a too stimulating effect on the bud, so that careful judgment must be exercised.

Some propagators advocate the removal of the buds from below upwards, but this is a matter of really very little importance. What is more essential is that the cuts be made clean and decisive, as any attempt at hacking or mutilation of the bark, or undue handling of the bud with warm hands, will greatly aggravate risk of failure. That portion of the wood removed with the bud can usually be jerked out with the point of the knife, thus leaving the bark and bud intact; but should the wood, as in some

cases, resist removal, it had better be left, as it will in no way interfere with the success of the operation. Often after removing the wood it is necessary to cut the bud finely to the desired shape, always using the petiole of the leaf as a handle. The number of buds obtainable from a branch will vary greatly; with roses it is often difficult to obtain more than five or six from an average stem, while in the case of many fruits a dozen or more may often be selected. For the reception of the bud a T-like incision is made on the stock, the longitudinal cut being about one inch in length and the transverse one sufficiently long to admit of the bud being easily covered. Holding the bud by the petiole, the point is assisted in entering below the bark by slightly raising the corners, when it will be found that with a little downward pressure the bark will usually lift of its own accord, until finally the bud is securely lodged in the cleft. Undue force must never be exercised, and if it is found that the bark does not open freely, it must be gently opened by means of the specially prepared handle of a budding-knife.

After the insertion of the bud the air must be excluded by raffia, but no wax or other preparation need be applied as in grafting. Amateurs often fail in the successful budding of roses through not keeping the newly inserted buds shaded for a few days after the operation. A little damp moss, or even the shade of a cabbage leaf, placed on top of the stem is all that is necessary to give protection.

In the case of indoor plants, the necessary shade, heat, and moisture is supplied artificially, so that there is less risk of failure. Needless to say, however, failures are very frequent with plants difficult of treatment, roses being probably the best subject on which to practise successfully.

Two or three weeks or so after the insertion of the buds the stocks should be gone carefully over and the bands loosened by cutting, while any stocks, the buds upon which have not taken, should be re-budded. In the following spring the stocks must be headed back just above the buds, as this will have the effect of throwing the whole vigour of the plant into the development of the bud. In some instances this heading back must be done gradually, otherwise a too sudden check may prove fatal, not only to the bud, but also to the plant. In heading back it not infrequently happens that shoots, or even suckers, will make their appearance below the bud, and these should therefore be removed immediately.

PRUNING

In the cultivation of fruit and other trees the operation of pruning is of the utmost importance, and to many who have no knowledge of plant physiology, or who are unaccustomed to make close observations with regard to the habit and growth of trees under varying conditions of soil and climate, the work cannot fail to be associated with a certain amount of anxiety and difficulty. By pruning the natural habit and growth of the tree is arrested, and it is made to assume definite forms such as could never be attained were the sap allowed to take its own course. Pruning is not restricted to the shortening back or removal of branches, or fruit spurs, but the roots of most trees also require pruning, in order to assist in the regulation of branches and to promote fertility. The ability of a pruner is gauged by his skill in controlling the sap of the tree, and in turning it to the best advantage in the development of leaf and branch, or in the production of flowers and fruit.

In a young tree, newly raised from seed, it will be noticed that the seedling develops a straight stem above ground and a correspondingly straight root below (fig. 22),

and as growth proceeds lateral branching of stem and root take place. These lateral or secondary growths are never so numerous or prominent when the primary stem or root has been shortened or cut back, or, in other words, when the flow of the sap to the extremity of the shoot or root has been arrested (fig. 22). The flow of sap in the primary stem may be checked, not only by cutting off the extremity of the shoot, but also by checking root action, which is often done unconsciously in the transplanting of seedlings from the seed-bed into nursery rows, at which stage in the tree's history the first pruning is unavoidably accomplished.

The system of pruning adopted in forest or timber trees varies very considerably from that adopted in fruiting trees; in the former the object is to obtain length and quality of wood, for which reason the natural branching of trees near to the ground is prevented as far as is practicable, whereas the fruit tree, should it not branch naturally, is induced to do so by artificial means, namely by the suppression, encouragement, or regulation of its branches and wood-buds.

The first essential in a young fruit tree is to give attention to its form, which must first be decided upon in the mind of the cultivator. In the case of a standard tree grafted five to six feet from the ground, three of the best positioned buds of the scion should be encouraged to grow freely throughout the summer, so that it may become

thoroughly ripened by late autumn (fig. 23). After the severest frosts of winter are over, each of the three shoots should be shortened back to within five or six buds from their base, cutting to a bud pointing outwards. In spring, when the buds begin to push forth, the total number of buds on the three branches should be reduced to eight or nine, and in such position as to give promise of a well-balanced head, as in fig. 24. At this stage the pruner's attention must be directed towards keeping the tree open in the centre in order to admit abundance of sunlight and air. In the following and succeeding few years these original branches must be cut back sufficiently hard in January or February to develop what would otherwise prove dormant wood-buds (fig. 25). The already developed fruiting spurs along the whole extension of the branch will benefit from the shortening back of the strong main shoots. In order to keep lateral growths in check, and prevent them from competing with the main branches of the tree, they must be systematically gone over and kept pinched back in spring, a practice too often neglected, mainly through want of time at this busy season of the year.

July is usually the best month for stopping the lateral growths, as by this time the wood is partially solidified and there is much less risk of the basal buds being excited into growth; also, should the leading branch be well furnished with fruit, the surplus sap will be utilised in its

development, as also will the buds which go towards the formation of the fruiting spur. The conversion of strong wood growth into weaker or fruiting wood is shown in fig. 26. *If a tree is continually* bearing fruit on spurs, these spurs must be constantly undergoing a change and extending in length; those newly formed being in close contact with the leading or main branches of the tree, and it is obvious that fruit occupying this position will be better nourished than when further removed from the direct flow of sap. Fruit spurs increase in growth year by year and gradually become further removed from their original position, until, if unchecked, bare portions or lengths of stem connecting the main branch with the spur are formed, as shown in fig. 27.

To regulate this defect it is necessary to adopt a system of spur-pruning, which consists in shortening back a portion of the spur each year: this will have the desired effect of retaining the spur in its original position. Too frequently fruit-spurs are allowed to become overcrowded, thus excluding light and air. Surplus growths must be removed wherever there is overcrowding, as fruit borne amidst clusters of spurs and shaded by excessive foliage is bound to lack colouring, which carries with it flavour —the most essential quality in all fruit. The thinning of spurs is not carried out to the extent which its practice merits, and could well be extended to standard or orchard trees with profitable results. Some varieties of plums are

characterised by the profusion of spurs they bear, and many of these would fruit more regularly and with more freedom if half of the spurs were removed.

Similar treatment would apply equally well to those apples and pears which fruit in alternate years, due to excessive spur formation, accompanied by overcropping, and a consequent weakening of the succeeding flower-buds. Cases are on record where apple trees, known to fruit in alternate years, have been induced to carry regular crops each year when a percentage of the blossoms were removed.

To return to the young tree, hard pruned for the first two years, we must now observe its vitality and habit of growth, as after the second year it will not usually require to be shortened back so closely. In fact, many strong-growing varieties of apples, such as Newton Wonder and Bramley's Seedling, are best left alone, the only pruning consisting of the removal of surplus branches and the regulation of spurs.

Considerable controversy has arisen as to whether trees should be pruned the first year they are planted or left to the second year. Each individual tree must be judged on its merits, as vigour of root and strength of wood are rarely ever constant, and it is these characters that very largely decide the advisability of pruning at the time of planting. There is no advantage in heading back a delicately constituted tree with insufficient root action to

force a growth of healthy wood in spring: if cut back at the time of planting, the result is often the formation of fruit-buds which further tend to weaken its vitality.

Many varieties of apples, although prolific croppers, are possessed of vigorous root action—as, for instance, Lane's Prince Albert,—and therefore submit to hard pruning. It may be concluded that all strong and healthy trees benefit rather than suffer by a judicious shortening of the branches at the time of planting, which in reality balances a somewhat similar operation unavoidably performed on the roots in transplanting. The varieties of fruits not pruned on the spur system are specially dealt with under their respective headings.

If in pruning a large branch is to be severed from the trunk, or a smaller branch from a larger one, the closer such branch is cut to the main stem the better, as then a healthful healing of the cut stem will ensue (fig. 28). Where the wood exposed assumes large proportions it may be stained to hide its unsightliness, while the bark surrounding it should be cut or pared with a sharp knife to facilitate the protrusion of the sap and the ultimate formation of a callus, the growth of which extends until the whole surface of the wood is covered.

In pruning or shortening back leaders for the continuation of wood growth, care must be taken to cut in the direction of the bud, also to an outward bud, and not one taking a direction towards the centre of the tree, as shown

in fig. 29. If the cut is made too far from the base of the bud, a snag will result. Snags, whether in young or old trees, have no useful purpose to perform, and in addition to proving unsightly, they provide, in decaying, refuge for spores of disease, and also harbour insect pests.

Root-pruning is another form of pruning that must not be overlooked. The operation affords a means of establishing uniformity between the roots themselves and the branches dependent upon them, and especially is it applicable to varieties of apples and pears, which must of necessity be grafted on vigorous-growing stocks. Fibrous-rooting stocks, such as the French Paradise and the Quince, very rarely require this treatment, but where their use is impracticable they, and stocks of like character, must give place to those that are possessed of vigorous root action, thus necessitating root-pruning if the best results are to be obtained. It is natural for all young trees to produce wood growth, the amount of which is increased when they are planted under favourable conditions of soil and climate, and on their own roots or those of an equally strong-growing stock, as in the case of the Crab or Wild Pear.

In transplanting, say, a three-year-old fruit tree from a nursery, the necessity will arise for a second root-pruning, the first root-pruning having taken place when the tree was removed from the nursery row, in which position it was probably grafted or budded. The third, or first root-

pruning after the tree is planted in its permanent quarters will probably have to be performed when the tree is between six and eight years old, at which age it will have become well established with a tendency to produce a luxuriance of woody growth. Root-pruning is most successfully performed at the fall of the leaf, or sufficiently early in the season to afford severed and damaged roots an opportunity of healing and thereby recovering a healthy condition while the soil is still warm. If the operation is delayed until December, the ground temperature has fallen and so new roots are not so readily formed in the following spring. In treating trees of five or six years' growth, these can be taken bodily out of the ground, and the strongest of their roots shortened by the aid of a strong pruning-knife (see fig. 30). Each cut should be made in a slanting direction on the upper surface, so as to induce the fibrous roots formed later to take a more horizontal direction through the soil than would be possible were the cut to be made on the under surface. Trees from eight to twelve years old and upwards require considerably more care in root-pruning, as, if the operation is performed in a careless or haphazard fashion, the tree will receive a severe check from which it may never recover.

In root-pruning a tree that has made a luxuriance of woody growth, it is advisable to reduce the stronger roots by degrees, or, in other words, extend the work over two or even three years. This can be accomplished by taking

out a trench half-way round the tree one autumn and completing the remaining half in the following autumn, in each case placing several wheel-barrow loads of such compost in the trench as will promote the speedy formation of new roots, as, for example, old potting compost, leaf-mould, and sand. The distance at which to open a trench will depend on the dimensions and size of the tree, and under no circumstances is it ever advisable to commence too close to the trunk; rather excavate in the direction of the trunk and not from it. In the case of an eight-year-old bush or pyramid apple, the average distance may be taken as from four feet to five feet from the stem, when in descending downwards exceptionally strong roots will be encountered, usually varying in number from five to eight, and these may be cut through with an axe, mattock, small pruning-saw, or other suitable instrument, and afterwards removed. All jagged or otherwise uneven ends must be planed and made smooth with a sharp knife, in order to facilitate healing, and to prevent an outbreak of disease in the form of canker.

Although root-pruning cannot be performed without considerable expenditure of time, and consequently money, it nevertheless repays the cultivator for his extra trouble, provided the work is systematically executed and the cost kept within reasonable limits. When a trench has been opened around a tree and it is found to admit of further extension towards the stem, this must be done with

caution, using a fork so as not to cut through the smaller and more fibrous roots, which by the way must be carefully pegged on the ball of earth as the work proceeds, finally being laid back in their original position and the soil packed firmly around them.

While the foregoing remarks apply more particularly to fruit trees, it must also be borne in mind that many ornamental deciduous and evergreen forest trees call for equally careful attention in order to keep them within the required limits, and to assume the shape or form most desired.

TRANSPLANTING

APART from hereditary barrenness and sterility, the failure of many trees and shrubs to flower and bear fruit is directly traceable to their having been planted at elevations, in aspects, and on soils totally unsuited to their requirements; therefore, before deciding to plant any particular species or variety of tree, the suitability of aspect, soil, and other essentials for their healthy development and fruitfulness must first be carefully considered. The operation of planting is in reality one of transplantation, or the removal of the tree from one position to another. The seedling is first transplanted from the seed-bed into nursery rows and finally to its permanent quarters, unless for some other reason it is again removed, as is often necessary when thinning plantations or in the removal of specimen shrubs or trees from one part of the garden to another.

Transplanting can never be performed without a certain amount of injury to the existing roots, which will vary in keeping with the amount of care exercised in the operation, the condition or humidity of the atmosphere, and the length of time the roots of the tree

remain exposed to the air before replanting. Trees in transit by rail or water often suffer severely, as it is practically impossible to remove them with soil clinging to their roots as is done when conveying trees over short distances or transporting by means of specially constructed carriers. Trees are best obtained from nurseries during November or early December, and should be heeled into moist soil until such time as they can be planted. The age at which trees or shrubs can be successfully transplanted depends upon the species or variety, and the fibrous and other characters of their roots, some being more sensitive to exposure than others. Provided that the necessary amount of care is taken, and that the mechanical devices to hand are of the most approved type, it may be safely said that a fibrous-rooted tree can be transplanted at almost any age. There would, however, be no practical advantage in transplanting fully matured trees, or those that show signs of natural decay. Old trees may be rejuvenated by transplanting into better soil; the expense of the operation, and the doubtful effect of such experiments, however, discourage the practice. There is no better time to plant deciduous trees than at the fall of the leaf, provided that the atmosphere is not then too dry. Probably the most favourable conditions are to be found throughout the month of November, when there is a general absence of strong sunlight, and the air is usually well saturated with moisture. Another reason

for autumn planting is that the soil is still warm from the effects of the summer's heat, thereby affording the injured roots an opportunity of re-establishing themselves before the winter sets in, and the soil temperature becomes lowered through the agency of snow and frost. While it is not absolutely essential that new roots be formed, it is nevertheless beneficial to the tree if the cut portions of the roots callus or heal over and so protect themselves from decay, which not infrequently occurs when trees are transplanted late in the year on wet, cold ground. When once a callus has formed over the cut surface roots are freely emitted as soon as the warm days of spring arrive.

While it is admitted that the month of November is preferable for transplanting trees, it must not be concluded that this is the only month in the year in which this work is successfully carried out; in fact, planting may be made continuous from October to the end of March, provided the weather remains mild and the soil free from excessive moisture. To continue planting in frosty weather and in wet sticky soil is to court failure. Evergreens do best when transplanted from the latter end of September to the beginning of December, but much will depend on the natural condition of the soil; in soils of a cold, wet, and retentive character, planting will be most safely delayed until spring, if it cannot be performed before December.

Drainage.—In preparing ground for the reception of

trees, it should first receive attention with respect to draining, except of course where the soil is naturally drained, as much of the land laid down to fruit undoubtedly is. The draining of land for fruit trees requires considerable experience, as it is not unusual to find the soil under large fruit trees as dry as dust in comparatively wet seasons, thus proving that a plantation of fruit trees is capable of absorbing an enormous amount of water, and in very rare cases does the rainfall of spring and summer penetrate below the root area. Draining, therefore, will apply more to the land that is to be planted with young trees, for should such ground be in a waterlogged condition, it will be quite impossible for roots to develop in a free and healthy condition. The most economical form of drain is an open or surface drain, as, when tile or pipe drains are laid, they eventually get disturbed by the roots as the trees develop in size, and are soon rendered useless, whereas the surface drain serves for all that is necessary until the trees are well established and in a position to make use of the surplus moisture.

Soil Conditions.—The ideal soil for the generality of trees is a deep, rich, fibrous loam, overlying a retentive subsoil; but unfortunately such a combination is of rare occurrence, and the cultivator is obliged to make the best of whatever soil Nature provides, be it clay, sand, gravel, or chalk. Wherever the soil is of such a character as will admit of trenching, this should be done, as there is nothing

more detrimental to the healthy development of young trees than for their roots to bore through a compressed or solid mass of soil which has remained undisturbed for generations. In gravelly clay soils it often happens that a thin stratum of hard gravel may be broken through and a comparatively useful soil reached below, or, even should it prove to be clay, the fact of the stratum of gravel having been moved will prevent the roots of many trees from cankering, as would most certainly occur had this precaution not been taken. If the greater proportion of the gravel can be removed, so much the better. Canker in thorn hedges can often be traced to causes of this kind. The presence of healthy thorns, oaks, and elms of mature age in a district forms a very safe guide as to the suitability of the soil for apples, and other fruits that succeed on a stiff, retentive subsoil. Pines, yews, beeches, willows, and numerous other trees act as soil indicators, and are equally deserving of attention when choosing land for fruit-growing.

While newly planted fruit trees require a comparatively fertile soil, it does not follow that all ground should be heavily manured at the time of planting. The planter must study the requirements of each individual tree, meanwhile bearing in mind that most young trees, especially when on vigorous-rooted stocks, rarely require manurial stimulants in their early stages of growth, the difficulty being, in many cases, to check growth

rather than to encourage it until such time as the tree has attained maturity.

Planting.—Having marked the position that the trees are to occupy, a hole should be taken out sufficiently deep and wide to accommodate the roots without their being in any way cramped. It is always well in digging a hole to make the sides deeper than the centre, and when the best results are desired, on no account should any inferior soil be left for the roots to rest upon. Having prepared the hole, the tree must be examined before planting and all damaged portions of branch or root removed with a sharp knife.

The general custom in planting is to place the tree to the same depth that it formerly occupied, but this rule cannot be rigidly enforced, as circumstances may demand its being placed deeper or shallower. It is never advisable to bury the roots of any tree too far below the surface of the ground, and the more horizontally they can be placed, and the less they are matted together or overlap one another, the better. The placing of soil over the roots must be done very carefully, using a portion of the top spit or surface soil, this being usually more friable and capable of finding its way into the crevices between the smaller roots than is soil obtained at a lower depth, and especially when thrown close to the stem of the tree, so that it may work down in the direction of the rootlets and towards their

extremities, and not *vice versâ*. When the necessary amount of soil has been utilised in filling between and covering over the roots, if of a light porous nature, it may be trodden down, but if largely composed of a heavy tenacious clay loam, it will settle without any undue pressure. Fig. 24 illustrates the planting of a young standard apple and the appearance of the tree after staking. If the tree requires staking, this must now be done, taking care to drive the stake so that it clears the more prominent roots of the tree; if two stakes can be used, so much the better, and in either case the tree must be securely fastened to them in such a way as to avoid any possibility of the bark getting rubbed during strong winds. Whenever the soil and surrounding ground is very dry and parched, one or more good waterings to settle the soil and to encourage root action are helpful. Where the condition of the tree or shrub is such as demands a continuous supply of moisture at the roots until established, the soil around its base must be made to assume the form of a basin, as this will admit of a more thorough soaking being given. If the trees are exposed to damage from cattle, sheep, or rabbits, they must be adequately protected by means of small meshed wire netting.

The planting of young forest trees is carried out on quite different lines from those recommended for fruit trees. The work must be performed quickly, and, as may be

imagined, the same attention to detail cannot be given, nor is it in any way essential to success so far as a forest tree is concerned. The methods usually adopted in planting forest trees are known as pitting, notching, and tumping.

MANURING

The manuring of fruit trees and other hard-wooded plants is associated with many difficulties and must therefore be cautiously performed, even by practical cultivators who are already familiar with the characteristics of the different species and varieties. It would be impracticable to devise a system of manuring without first considering the conditions of soil and climate to which the respective plants will be subjected, and without an intimate knowledge of the plant's habit of growth. The inadvisability of manuring young trees with too heavy dressings of farmyard manure at the time of planting has already been demonstrated, as very few trees, except those which have been carefully transplanted and possess a wealth of fibrous roots, are capable of assimilating large quantities of food from decaying organic matter. The presence of fresh, rank manure in close proximity to strong roots which have been newly pruned will often retard growth, and even induce decay of the heart wood before the cut surface has an opportunity of healing. Continuous supplies of liquid manure produce a disastrous effect when applied in large quantities to trees growing in heavy retentive soils,

as the sediment of the manure tends to interfere with the capillarity and proper aeration of the soil, thus causing stagnation. The practice prevails among many growers of mulching the surface of the ground around the trees with a coating of dung in the autumn, but the objection to giving farmyard, and especially town, manure in this way is that its presence invariably tends to encourage and facilitate the breeding of many insect pests.

Having periodically inspected different varieties of fruit trees manured with various artificial fertilisers, I find the results of such a system of manuring unconvincing, as many of the trees on unmanured plots often appear considerably more healthy and prolific than those to which artificial manures, supplying one or more constituent, have been applied. The fruit-grower finds it even more difficult than the farmer to obtain an adequate supply of farmyard manure, and much of that which is available for his requirements is not the produce of animals fed on liberal rations of concentrated foods, and consequently possesses little fertilising value. Its chief value is that it ameliorates the mechanical condition of the soil, thereby producing a better medium for the development of fibrous roots. Since the introduction of motor power the market gardener finds the supply of "farmyard" manure still more inadequate, and it is necessary for him to turn his attention to special manures in order to supply those fertilising ingredients in which the soil is deficient, and of these the

most important are nitrogen, phosphoric acid, potash, and lime.

There are many forms in which nitrogen may be supplied to the soil by artificial manures, and the principal of these are nitrate of soda, sulphate of ammonia, nitrate of lime, and calcium cyanamide or nitrolim.

Nitrate of soda is a white or brownish crystalline solid of from 95 to 97 per cent. purity and containing from 15 to 15½ per cent. nitrogen. It is applied to the soil as a top-dressing, and, being very soluble in water, it is not retained by the soil and must not therefore be applied until the crop is ready to make use of it. It causes a rapid development of both root and shoot systems and tends to make the plant drought resisting. Too heavy dressings are injurious, as the plant becomes overgrown, and the formation of flowers, fruit, and seed is retarded, while when in excess it spoils the texture of clay soils. It does not take lime from the soil but rather economises it, and is applied at the rate of about ¾ to 1½ lbs. per sq. rod, or about 120 lbs. per acre. The price may vary from £10 to £11 per ton according to the season and demand.

Sulphate of ammonia is a by-product in the manufacture of coal gas; it is a white crystalline solid and contains about 20 per cent. of nitrogen. It is soluble in water but is not washed out of the soil as easily as nitrates, a large quantity of the ammonia being absorbed by the organic

matter in the soil and retained fairly near the surface. The roots of the plant, therefore, penetrate less deeply, and on this account sulphate of ammonia gives better results than nitrates in wet seasons. It is unsuitable for soils deficient in lime, as this constituent is necessary to enable the ammonia to be liberated and become useful as plant food. This manure is best sown fairly early in spring, as nitrification has to take place before the nitrogen is ready for the plant. It is applied at the rate of from $\frac{3}{4}$ to $1\frac{1}{2}$ lbs. per sq. rod, or about 120 lbs. per acre, and costs on an average about £13 per ton.

Nitrate of lime, or calcium nitrate, which is produced from the action of nitric acid on lime, is usually granular and light brown or slatey in colour, and contains from 13 to 15 per cent. nitrogen. Its chief disadvantage lies in the fact that it is very liable to take up water from the atmosphere and become pasty, so that after using, the barrels must be kept covered to keep out moisture. The difficulty may also be obviated to some extent by mixing with quicklime. The remainder of its properties are similar to those of nitrate of soda, to which it has shown itself quite equal in effectiveness. In fact, on soils deficient in lime the results from the application of nitrate of lime are slightly superior to nitrate of soda, supplying the same quantity of nitrogen.

Calcium cyanamide, or "nitrolim," is produced by heating calcium carbide. It is sold in the form of a

black, finely ground powder, and contains in the case of the best samples about 20 per cent. of nitrogen. It is necessary to apply this manure three weeks or so before sowing seeds, as it is deleterious at first to germination, but in the case of well-established crops and fruit trees it can be used as a top-dressing. It should not be applied to damp soils or those containing an excess of organic matter, unless there is a plentiful supply of lime present. The rate of application is from $\frac{3}{4}$ to $1\frac{1}{2}$ lbs. per square rod, and the cost is about £12 per ton.

The chief sources of phosphoric acid are mineral and bone phosphates, basic slag, and bone manure. Of these, superphosphate produced by the action of sulphuric acid on bone or mineral phosphates is an acid manure and contains from 26 to 38 per cent. of soluble phosphate. Owing to its acid nature, it is inadvisable to apply this manure to any soils deficient in lime. It is applied at the rate of from 3 to 5 lbs. per square rod, and costs from £2, 10s. to £3, 5s. per ton.

Basic slag is a by-product in the manufacture of Bessemer steel, and usually contains from 30 to 40 per cent. of total phosphates according to grade. As it also contains a certain amount of free lime, it is of the greatest value on soils deficient in lime, damp in nature, and containing a high percentage of organic matter. It is applied at the rate of from 3 to 6 lbs. per square rod, and the price may vary from 35s. to 60s. per ton.

Cultivators of the vine know too well the value of incorporating a liberal dressing of ground or crushed bones with the soil in which the vines are planted, as phosphates in this form are slowly available and thus benefit the plant over a long series of years, in addition to keeping the soil open and porous and supplying a small percentage of nitrogen in addition to phosphoric acid. Fibrous turf taken from old pasture is very deficient in phosphates, as this constituent is continually removed by grazing stock; but where the bones of animals ground to a fine powder or chemically dissolved are returned to the pastures, they produce a more lasting and stimulating effect than do the majority of other phosphatic manures. The forms in which bones are applied to the soil are usually as either raw bones, steamed bone flour, dissolved bones, or boiled bone meal. Raw bones are usually poor in quality and very slow in action, being only crushed to from ¼- to ½-inch size. They contain, on an average, about 20 or 23 per cent. of phosphoric acid and from 2 to 3 per cent. nitrogen. Steamed bone flour is merely the product of steaming boiled bones for twelve hours under pressure, with the result that the percentage of nitrogen is reduced; they contain from 23 to 25 per cent. of phosphoric acid and from 1¼ to 1½ per cent. of nitrogen. Both raw bones and steamed bone flour prove very beneficial on light soils deficient in lime, if applied at the rate of about

8 lbs. per square rod. Dissolved bones are obtained by chemically treating bones with sulphuric acid, which produces a bone superphosphate. They are similar to mineral superphosphate in all their properties except that they contain a small proportion of nitrogen, usually about 1 per cent.

The prices of bones and bone products for use as manure vary considerably, usually in proportion to the quantity of nitrogen they contain. The cost, however, is usually somewhat high, as there is only a limited supply of genuine bone manures on the market, while there is an ever-increasing demand.

In the application of phosphates to the soil, those manures the constituents of which are only of a slowly available character may be worked in at the time of preparing the soil, as in the case of bone manures and basic slag, whereas in the case of superphosphate and those which are quickly soluble, they are best applied by forking into the surface soil in spring when the plantations are being dug over.

Kainit, sulphate of potash, and muriate of potash may be used to supply the necessary potash to the soil, and the necessity for the application of this constituent may usually be said to vary with the foliage development of the plants.

Kainit is a crude potash salt and contains about 12½ per cent. of potash, and, on account of the impurities

it contains, is best applied in winter at the rate of from 1½ to 4½ lbs. per square rod. It is best applied to light chalk soils and tends to make them more compact and retentive of moisture. Price about £2, 5s. per ton. Sulphate of potash and muriate of potash are both purified salts of potash, and in the best grades cost £10 per ton. The former contains as much as 50 per cent. of potash, and is preferable to kainit where carriage is expensive and on soils deficient in lime. The muriate of potash is used fairly extensively for all kinds of fruit trees, and is much more soluble than the sulphate, and is therefore applied in the spring at the rate of ¾ to 1 lb. per square rod. Many colonial farmers have found that by manuring their orchards with 2 cwts. of muriate of potash, 5 cwts. bone meal, and 1 cwt. of nitrate of soda per acre yearly, annual yields of apples at the rate of 7 tons per acre may be produced; this amount of potash is rarely necessary, however, even on light soils in this country.

It is evident that where trees are deep-rooting and possess but few fibrous roots, the soluble properties of the manures will not be assimilable to the same extent as in the case of dwarf trees grafted on the more fibrous rooting stocks like the Quince and Paradise, and where by careful cultivation the roots are kept under control and restricted to the surface soil. Many old plantations, the trees in which produce only small undersized fruits, afford sufficient

evidence of the results which attend an unfertile condition of the soil, impoverished by the continual drain upon it without replacing those ingredients which are continually being removed.

Where pastures are grazed by stock it becomes essential to replace those constituents removed by the animals and which are only partially returned in their excrements. In the case of arable land similar conditions are to be found, but for some unaccountable reason many growers of fruit seem to consider it altogether unnecessary to use any system of manuring for their trees.

Alluvial soils, and those which are naturally rich in fertilising ingredients, will retain their fertility longer than soils of a "hungry" character or those which are deficient in plant food. It is always difficult to devise a system of manuring for mixed plantations or where the crop is made up of a number of varieties of fruit, or even of varieties of apples; but where one kind of fruit, such as strawberries, or one particular variety of apple is planted in sufficient numbers, there will rarely be any great difference in the habit of growth.

All fruit trees should be manured at that period when they most require assistance, and in all cases sufficient time must elapse for those manures of an insoluble character to become available. It is sometimes advised to apply manures after the fruit has set, the idea being that the food-supply goes directly towards the development of the fruit; but

this is not entirely correct, as, if careful notice is taken, it will be observed that the successive fruit- and wood-buds are also largely benefited, the former becoming well plumped up and healthy as spring advances, while the leaf area is considerably increased. No tree can ever produce fruit of good quality unless it is clothed with a healthy supply of foliage, the leaf being the factory for the manufacture of the food material essential to the growth of the plant. This fact is very clearly demonstrated when the foliage is injured and its function destroyed by fungoid or insect pests.

One ton of farmyard manure would contain about 12 lbs. of nitrogen, 5 lbs. of phosphoric acid, and 14 lbs. of potash, and if applied to a soil deficient in phosphates, would tend to stimulate woody growth at the expense of flower and fruit production. On the other hand, farmyard manure, containing as it does a large quantity of potash and only a very small quantity of phosphoric acid, suits chalky soils, many of which contain a fair percentage of phosphates but only a little potash.

Soils containing humus or decaying vegetable matter are well supplied with nitrogen, and in such cases it will be observed that a rank leafy growth will develop which should be corrected by supplying phosphates and potash.

It will thus be seen that the greatest judgment must be exercised in the economical application of all manures, as their use entails considerable expense. Concentrated

nitrogenous manures like nitrate of soda, containing 15 per cent. nitrogen, will cost about £12 per ton, others being proportionately dear, and while the farmer rarely gives a dressing of more than 2 cwts. per acre, this quantity is often insufficient to apply to the same area of land under fruit. Mistakes are very frequently made in applying stimulating nitrogenous manures to trees and bushes which are in a state of partial decay or the growth of which is stunted, in the hope that they may be invigorated. Thus it should be understood that when a tree has become stunted or starved over a long number of years, as for example in the case of gooseberries which are kept cut hard back in nurseries for several years, it is quite impossible to force growth by any system of manuring, however well devised. Both phosphatic and potassic manures will tend to improve the quality and flavour of the fruit, except in the case of those trees which in addition to their youth are strong rooting, like the Crab and Pear. All manures where possible should be forked just under the surface of the soil, the slowly soluble ones in the autumn and those more easily available in the spring.

Apples and Pears.—For apples and pears to succeed, the surface of the ground must be regularly tilled and kept free from weeds, and grass especially should never be allowed to grow if the trees are to thrive. In the majority of cases the best results are obtained where farmyard manure is used in conjunction with artificials, and for

apples anything from 20 to 25 tons per acre of short dung may be given, supplemented with from 4 to 8 cwts. of a phosphatic manure like basic slag or superphosphate, and from 1 to 3 cwts. of sulphate of potash; or where the soil is light in texture, from 5 to 8 cwts. of kainit may be substituted for the more concentrated form of potassic manure. Anything from 2 to 4 cwts. of nitrate of soda should be applied in spring to those trees that present a good show of fruit, and this manure, being in a readily available form, may even be applied after the fruit has set and where it is no longer subject to injury from frost.

Plums.—Plums do not respond to such large dressings of farmyard manure as do apples and pears, while in many instances established trees in good fruiting condition are benefited by applying from 6 to 8 cwts. of basic slag, followed in spring by from 2 to 4 cwts. of nitrate of soda per acre, the latter manure being given in two dressings and diluted with an equal quantity of salt.

Gooseberries.—Gooseberries always benefit from dressings of short dung at the rate of from 12 to 15 tons per acre, with the addition of from 5 to 6 cwts. of superphosphate or other phosphatic manure, and from 1 to 2 cwts. of sulphate of potash, from 3 to 4 cwts. per acre of nitrate of soda being given early in the year, when it may be washed in by rain and so tend to increase the size of the fruit.

Raspberries.—Raspberries, being surface rooting, are

benefited very considerably by heavy dressings of dung, anything up to 30 tons per acre being given; while if half this quantity is used, it should be supplemented by light dressings of say 3 cwts. of superphosphate and 1 cwt. of sulphate of potash per acre.

The above figures will serve merely as a guide to manuring, and, as already remarked, much depends upon the individuality of the tree.

LIMING.

The soils of old kitchen gardens and many orchards are often deficient in lime, due to the incorporation of large quantities of farmyard manure, garden refuse, leaf mould, and other organic matter. Ultimately these soils become "sick" or excessively sour or acid and unsuitable for the healthy development of plant roots. If 1 per cent. of lime is not present in a garden soil it may be considered deficient in this constituent, and where cherries, and other stone fruits which delight in a calcareous soil, are to be cultivated liming is an important essential.

The essential elements of plant food—nitrogen, phosphoric acid, and potash—may be present in adequate quantities, but soil acidity or absence of lime may nullify their usefulness. Not only does lime neutralise soil acidity and serve as plant food, but it considerably ameliorates the mechanical texture of soils. It aerates

heavy soils and makes them more porous, and therefore warmer and better drained, while light soils become more retentive of moisture, especially where lime in the form of chalk or marl is applied to them, as they only contain a small percentage of organic matter, which would be too easily acted upon by the more caustic forms of lime, and in being rendered soluble would be quickly washed out of the soil.

The application of lime to heavy clay soils brings about an important chemical change whereby much of the insoluble phosphates and potash are rendered available as plant food.

Bone compounds, superphosphate of lime, and gypsum consist of lime saturated with an acid and should not therefore be applied to soils sour in character, as this acidity can only be neutralised by the use of such forms of lime as quicklime, slaked lime, chalk, limestone, and manures such as basic slag and basic superphosphate. Lime should never be used in conjunction with sulphate of ammonia or similar compounds.

Action of Soil Bacteria.—The humus or organic matter in soils contains what is termed organic nitrogen, or nitrogen and carbon combined. This organic nitrogen does not become available until it has undergone the process of nitrification, *i.e.* until it is oxidised into nitric acid, which combines with lime or any other soluble base such as potash, and so forms an available nitrate. The

vital activity of certain bacteria which inhabit the soil is responsible for nitrification. Their influence causes the organic matter in the soil to be changed into water, carbonic acid, and ammonia, the last-named being finally converted into nitric acid.

A warm soil is more favourable to nitrification than a cold one, and it must of necessity contain some base like carbonate of lime with which the nitric acid produced can combine and so benefit plant life. The liberation of nitrogen from ammonia compounds is largely due to these bacteria.

Application of Lime.—Generally speaking, 1 ton of chalk burnt in a lime-kiln will yield from 11 to 12 cwts. of quicklime which, if the sample is a good one, will contain 85 per cent. of calcium oxide. In purchasing burnt lime a guarantee should always be obtained, as a large percentage of impurities, such as magnesium compounds, is very liable to prove harmful, especially to young roots. It is usually quite twelve months before lime exerts its full influence on the soil.

On account of its tendency to sink into the soil lime should be applied near to the surface, the more active and caustic forms, such as ground lime, at the rate of from 10 to 20 cwts. per acre, or ground limestone at the rate of 40 cwts. per acre, while as much as 10 tons of chalk may be applied to one acre of land, in which case it will last for as many years.

Gas lime is sometimes freely used in gardens as a means of destroying insect pests, but must be used cautiously on account of the sulphur compounds present. It should be applied in autumn, but only after it has been in a compost heap for twelve months and turned several times. If allowed to lie on the surface no bad results will attend its incorporation with the soil in the spring. All forms of lime are useful in combating insect pests and fungoid diseases.

FRUIT TREES

APPLE (*Pyrus malus*, Natural Order Rosaceæ).

It is very rarely that trees raised from the seed of well-known varieties of apples perpetuate their parental characteristics, therefore in the propagation of this universally popular fruit it is customary to resort to grafting. The stocks upon which apples are usually grafted are the Crab Apple, Nonsuch broad-leaved Paradise, Doucin or Dutch, and French or Narrow-leaved Paradise. The latter, however, is now little used, as it is short-lived and of a starving character. The English varieties of the Paradise stock are quite the reverse, and apples grafted upon them will continue prolific for upwards of fifty years; the seedlings obtained from the pips of cider apples are also occasionally employed as stocks. In selecting any particular stock much will depend on the general characteristics of the variety of apple to be grafted, also the soil and position in which it will ultimately become established.

The Crab stock assumes a very robust habit of growth, particularly in heavy, loamy soils, overlying a retentive clayey subsoil; also its longevity as compared with the

other stocks mentioned recommend it in the raising of orchard trees. It also proves of value in strengthening the constitution of many of the finest varieties of apples which are comparatively weak when grown on their own roots, or when grafted on a fibrous-rooting stock like the French Paradise.

The narrow-leaved Paradise, or any stock of similar habit, has a dwarfing effect on the graft or scion, and for this reason all stocks having a tendency to produce shallow and fibrous roots are to be preferred when the object of the cultivator is to procure fruit at the earliest possible period in the life of the tree. These fibrous-rooting stocks are admirably suited for ordinary garden soils, in which they respond freely to liquid and other readily soluble manures, although nurserymen do not use these to the same extent as they did some fifty or so years ago.

For the generality of apples, when grown either as pyramids, espaliers, or bushes, the broad-leaved Paradise, Doucin, or similar stocks are to be preferred, being neither too vigorous nor too weak, and therefore suit the majority of soils. Notwithstanding the greatest care in the selection of stock and scion, it will always be found that some of the unions, even when performed under exactly similar conditions, are not so satisfactory as others.

The planting of apple trees, although meriting considerable care, is too often carried out on too lavish a scale, particularly where a few trees are being dealt with;

if the simple rules as given on page 65 are adhered to, this is all that is necessary. In ordinary fertile garden soil it is a mistake to apply manures of any kind at the time of planting, as the soil has every capacity for the promotion of root action, and excessive manuring at this stage may have the effect of retarding rather than promoting growth. Should newly formed roots of a gross character avail themselves of an excess of food, the result will undoubtedly be the formation of woody growth, a condition which the cultivator has difficulty in checking, and at the best is badly accomplished by pruning and mutilation of the tree at a later stage of its growth, when, under ordinary circumstances, it would be prolific and in full bearing. Excessive or close pruning has been overestimated, and exaggerated in many instances, principally due to the lack of experience on the part of some enthusiastic writers on the subject.

In pruning young, newly planted standards, reduce the number of branches to four or five; cut each of these back to an outer bud at a distance from six to eight inches from the preceding year's growth or graft, as the case may be.

If the tree is possessed of vigorous root action, these dormant buds will develop strong shoots in the following year. It is a mistake to prune newly planted trees too hard the first year, while frequently it is better to leave them unpruned, unless it is thought that they

have sufficient strength of root to produce or force strong wood in the spring. Winter pruning may be performed with safety any time during open weather from October to March, the early months of the year probably proving the best. After having decided on the number of main branches to each tree, it will be necessary to carefully regulate the lateral growths or breast-wood each year by pinching, pruning, or whatever practice is thought desirable so long as the object in view is to promote the formation of fruit-buds.

There are a few varieties of apples, like Irish Peach and Lady Sudeley, that fruit at the end of the branches and therefore must not be spurred back. The student must study carefully the habit of each tree before pruning, as no hard-and-fast rule can be laid down as to how this or that tree should be treated.

It is customary in this country of varied soils and climate to see apple trees growing in soil altogether unsuited to their cultivation, with the result that they soon assume irregular habits of growth, or even become cankered or diseased, a condition which no system of pruning or cultural treatment can correct or modify in the smallest degree. Old pyramid trees are often pruned close year after year until they cease to bear fruit; this can, however, often be effectively remedied by thinning all the lateral spurs and allowing the leaders to make a free growth for at least three years, merely shortening

back the tips sufficiently to prevent too many lateral buds remaining dormant.

The summer pruning of apples is best performed throughout the month of August, as, if done in June or July, secondary growths are produced which again require pruning, and later give rise to a cluster of weakened growths altogether unsuited to form robust and healthy fruit spurs.

As established trees require little or no pruning other than keeping the centres open to light and air, the spurs are meanwhile becoming irregular and overcrowded, and, when time admits, will pay for attention. It is always easy in theory to say what ought to be done, but quite another matter to carry out in practice the well-intentioned advice of the theorist, which he among others would probably be the least likely to adopt. Fig. 31 provides a good illustration of how spurs become disarranged, wood growths occupying the place of fruit spurs and *vice versâ*.

In pruning for the development of wood growth we do not always get the results we anticipate, as is shown in fig. 32. It is usually supposed that the terminal bud will produce the greatest vigour of growth, and that there will be a corresponding reduction of vigour from the terminal down to the base of the stem; but there are many exceptions to this rule.

The principal shoots of cordon trees should only be

shortened when they fail to make spurs, while in the case of espaliers the lateral shoots must not be pruned back for a season, as, when this is done, the regular formation of the lateral tiers of branches often receives a severe check. After a season's growth the leaders can be regulated, the lower ones being left a foot or so longer than the upper ones, as the sap naturally rises to the highest branches (fig. 33), and if they are allowed too much freedom the lower branches will be deprived of sap and ultimately perish. All strong wood growths along the lateral branches should be shortened back in August to within three or four buds at the base; these will usually develop weakly growth, which can be spurred back at the winter pruning to form fruit-buds in due course. Amateurs often allow these lateral growths to assume such proportions that eventually the question arises as to what are to be considered the leading branches of the tree. Care must always be taken to see that laterals of cordons, espaliers, and pyramids do not enter into competition with the leading branches; a defect which can be more easily remedied in the case of bush trees.

APRICOT (*Prunus armeniaca*, Natural Order Rosaceæ).

Apricots are never grown satisfactorily on their own roots, and it has been found necessary to utilise as stocks the seedlings of several varieties of plums such as the

Mussel, Myrobalan, Brussels, St Julien, Brompton, and also seedling almonds. Occasionally seeds are sown with a view to raising new varieties, a practice which has frequently been attended with success. Moor Park serves as an example of a well-known variety which can be reproduced from seed. Budding is the general method of propagation, and the months of June and July are found most favourable for this work; the buds being then more readily detached from the wood. The beginner must be careful not to insert blossom-buds instead of wood-buds; the former are readily recognised on account of their plump and rounded appearance. Grafting should only be resorted to when the buds of any particular variety fail. As the scions of an apricot are considerably advanced by the month of March or April, they are best removed from the parent plant early in January and heeled into moist sand, contained in a box, and kept in a cool, shaded situation.

Apricots prefer a wall on which to grow, and the warmer and more sheltered the aspect the better. Breda, a hardy and prolific variety, is, however, an exception, and will thrive equally well as a standard or bush, provided that the position is an ideal one as regards warmth and shelter. Ground set apart for apricots should be well trenched and drained free from stagnant water, as these conditions are fatal, particularly in winter. In low-lying or damp localities, the excessive moisture continually

present in the air glues the pollen of the flowers together, thereby obstructing the process of fertilisation, with the result that the fruits fail to stone and consequently fall to the ground. Always avoid planting apricots too deep; the nearer the roots can be kept to the surface the better will the trees prosper. When planted as standards they should be quite eighteen feet apart, but a common practice is to plant with dwarf and standards alternately, and later to remove every other tree as more space is demanded. Apricots are not adapted for horizontal training, as, when so treated, the branches die back, owing to the ascension of the sap to the terminal buds or ends of the branches becoming arrested; therefore, when planted against a wall they should be made to assume the form of a fan.

An objection raised against the cultivation of apricots is that the stronger branches of the tree are continually dying back, but many years ago I had occasion to prove that the cause of this decay was very largely, if not solely, due to the stronger roots, corresponding in growth to these branches, having penetrated into soil altogether unsuited for their healthy development. In order to minimise, if not altogether prevent, this decay it is necessary to give early attention to the roots of young trees for the first four or five years of their growth, carefully shortening back or pruning all that show a tendency to become gross. When the trees continue to crop well and

regularly, it may be assumed that the roots no longer require attention.

The fruit of the apricot is borne on the preceding summer's growth, and also on spurs of wood two, three, or more years old. Extension shoots should be allowed to develop where required, and their lateral breaks summer-pruned in order to form spurs. The older spurs, composed of fruit- and wood-buds, must be regulated carefully, and if not too prominent are best left alone: the finest quality fruit is to be found on the one- and two-year-old wood. Shoots of vigorous growth should have the upper portion removed in July, in order that the sap may be diverted into the lateral growth of less vigour.

The shortening back and tying in or nailing of lateral summer growths must be attended to each autumn; these should occupy the intermediate spaces between the main branches, say at every twelve inches, the shoots being shortened back to a like length. Shortly after fruiting these laterals must be cut out to make room for younger growths. The pruning of apricots (fig. 34) differs somewhat from that of peaches, inasmuch as it is necessary to lay in a larger number of main branches, while the shoots which break from these must be cut back to three buds to form fruit spurs. The spurs formed along the extension of the branches are of a permanent character, and must therefore be regulated each spring by disbudding, as, being added to each year by new growth, they very soon become too

numerous. The spurs must always occupy a position on the upper side of the branch and at a regular distance of say five to six inches apart. As the spurs enlarge and become further removed from the main stem or branch they must be cut hard back, so that very gradually the whole of the old spurs are removed and young growths break from the base to form again into spurs.

Apricots, like plums, are liable to become constitutionally weakened by over-productiveness, and on this account it is advisable to limit the amount of fruit borne by removing it by hand after it has stoned: if the tree is perfectly healthy a heavy crop will affect it but little. If exhibition or choice dessert fruit is desired, one fruit to each spur will be ample, otherwise three fruits to each spur may be allowed to develop. Thinning must be commenced early, when the fruits are no larger than peas, secondly when about the size of hazel nuts, and a week or a fortnight later for final selection.

BILBERRY (*Vaccinium Myrtillus*, Natural Order Vacciniaceæ).

The Bilberry or Blackberry, as it is more popularly known in Scotland, is very rarely found as a cultivated plant in gardens, principally owing to the difficulty in re-establishing it when taken from its natural habitat. It is a deciduous shrub, and under favourable conditions grows

to a height of one or two feet, and is commonly met with on stony heaths, where its roots secure a good hold of the peaty soils.

The fruit, a small dark purplish berry, has an agreeable acid flavour, and is in great demand for making tarts and preserves. The usual method of propagation is by layers and divisions of the root-stock. At no stage of the plant's growth is pruning necessary.

BLACKBERRY (*Rubus fruticosus*, Natural Order Rosaceæ).

The Blackberry or Bramble is by no means unfamiliar in many of the best appointed gardens in this country, and although the plant assumes a wild straggling appearance when left to develop at nature's will, it can nevertheless be made ornamental and useful if well managed. Varieties such as British, Logan Berry, Cut-leaved, Wilson Junior, and the Japanese Wineberry, all do well when trained over rustic trellis-work or arches similarly constructed. Propagation is effected by suckers taken from the parent plant in late autumn or early spring, and planted in carefully prepared ground at regular intervals; the distance varying according to the strength of the variety selected. After planting, the canes should be cut down close to the ground, in order to strengthen root action. Should the canes of the first year's growth be

unusually weak, they must again be shortened, the primary object being to secure a limited number of from five to six good stout canes, which when well ripened by the sun will fruit abundantly. After fruiting, shorten the canes in order to throw more strength into the new suckers, and to afford them additional air and light; finally, before November, remove the whole of the canes which have borne fruit, also thin out any surplus suckers, and tie the remaining ones securely in order to prevent their being broken down by strong winds.

Many of the species and varieties of Rubus are peculiar as to soil requirements. The majority flourish in deep retentive loams, or even moist sandy soils. In soils of a dry character, considerable difficulty is experienced in establishing young plants, while too frequently transplanting, or any operation that tends to disturb the action of the roots, must be avoided. When plantations become exhausted, as indicated by the weak growth of the plants, it is never advisable to attempt the renovation of the soil by excessive applications of natural or "artificial" manures, as better results will attend the making of plantations on land previously occupied by a vegetable crop, or ground newly broken up, as is the case with much of the land in fruit-growing districts.

CHERRY (*Prunus avium*, Natural Order Rosaceæ).

Cherries are usually propagated by budding or grafting on seedlings, raised by sowing the stones of *Cerasus Nakabeb* for dwarf trees, varieties like the Duke and Morello doing remarkably well on this stock, while stocks raised from the Gean or Wild Black Cherry are well adapted for all purposes, particularly for standards and strong growing varieties like the Bigarreau. New varieties of cherries are raised from stones direct, and in sowing ordinary varieties, sporting frequently occurs. It is a common practice to stratify the stones until spring, when those showing signs of germination are planted in drills and covered with several inches of fine soil. In the autumn of the second year the seedlings should be planted out into nursery rows.

When it is proposed to graft cherries, the scions must be taken early, before the buds are advanced in growth; otherwise the operation may prove a failure, and to prevent disappointment it is well to cut off the scions towards the end of January or early in February, and heel them in a cool soil and situation until required in March. In removing scions from old trees crowded with fruit-buds, care must be taken to see that one or more wood-buds are present, as without at least one wood-bud (usually the terminal bud) no growth of wood will be forthcoming (fig. 35). In budding standards the higher the buds are placed,

within reason, the better, as if low they are more subject to injury, and thus cause gumming.

Cherries, like other stone fruits, do not lend themselves to knife-pruning, although, to ensure a well-trained and evenly balanced tree, judicious pruning of the root and stem is necessary while the tree is young, after which they are best left to grow at their own free will. If the knife be freely used, particularly in autumn or early spring, the trees will exude gum much more freely than if they are cut in the summer; and as gumming in any form is attended with injurious results, as little pruning as possible must take place. At all times, it is best performed when the trees are in full leaf.

Young cherry trees make very little growth during the first year, so that little pruning is necessary until the following winter; but should a strong woody growth be formed, it is best to lift the tree in the autumn and shorten back any strong roots, or such as may account for luxuriance of growth. The branches of a young cherry must be cut back so as to build up a symmetrical and well-balanced tree, after which little further pruning is required, the tree becoming a regular and continuous cropper until old age and decay deprive it of its branches (fig. 36).

Large standard trees must be let go, but on walls disbudding in spring or systematic pruning of the spurs must be adopted. This consists in cutting back the current season's shoots to within two buds at the base,

and shortening spurs which become extended or far removed from the branches, while here and there it will be necessary to thin out such spurs as are overcrowded, which they readily become as the tree grows older. On the laterals or wood growths of young trees fruit-buds can quite easily be produced by pinching out the growing point.

The Morello cherry requires a totally different method of pruning from that of other varieties, as its fruits are borne on the wood of the previous year's growth, and not infrequently all the buds along the extension of the branch are fruit-buds, the terminal bud alone being a wood-bud (fig. 37). When once the tree has been trained into shape, it should not be touched with a knife oftener than is necessary; if trained to a wall it should be treated similarly to a peach; yet there is no reason why the breast wood should not be allowed to grow away from the wall, when, if not overcrowded, a large amount of fruit is produced. Young trees having a tendency to produce an excess of vigorous wood growth should be carefully lifted, and replanted in order to check their vitality; the longer the roots are left exposed, in reason, the greater will be the check to the tree. When a certain amount of pruning is necessary, care must be taken to leave wood-buds where extension branches are required, but if the tree is well handled in the spring as regards disbudding, there should be little or no need of using the knife in winter.

CURRANTS (*Ribes nigrum et rubrum et album*, Natural Order Grossulariaceæ).

Black Currants, except when it is the intention of the cultivator to raise new varieties, are propagated from cuttings which readily take root in any ordinary soil, provided it be sweet and moist.

The cuttings should consist of vigorous and well-matured young shoots with a heel of the previous year's growth attached whenever possible, and without causing injury to the remaining branches of the tree. The length of the cuttings need not exceed one foot, and they should be inserted about four inches under the surface of the soil, previous to which the terminal bud or top of the shoot should be removed; but none of the lower buds need be disturbed, as, when the cutting is rooted, these buds form suckers upon which fruit is freely borne later on.

The pruning of black currants consists in shortening back the first branches produced in the autumn of the first year, by which time the tree will be one year old. The cuttings are best inserted in early autumn, as they then have an opportunity of becoming fully established before the ground gets cold and frosts make their appearance.

The trees bear fruit freely on the young wood (fig. 38), therefore all old black wood must be regularly cut out each year, and the more freely the knife is used on wood of this kind the greater will be the growth of new wood

to take its place. Given a moist sweet soil, not too exposed to sunshine, black currants will flourish and bear heavy crops for a long number of years so long as the old black wood is kept cut away; and fortunately it has been the writer's lot never to have been troubled with the black currant mite.

Red and white currants are propagated in the same way as black currants, with the exception that the buds are removed from the lower portion of the stem of the cutting so that a clear stem is obtained (fig. 39). This prevents the formation of suckers; in fact, it is just the opposite mode of treatment to that advised in the case of black currants from cuttings. Standard currants are grown largely in many gardens, in which case it is advisable to graft on stocks of *Ribes aureum.* Unless grown in large quantities, it is always necessary to protect the fruit from birds, and it is for this reason that the red and white currants are not grown extensively in small gardens; late frosts are also very damaging just as the fruit is about to set.

As regards the method of pruning to be followed, red and white currants both differ from the black varieties. Five or six buds are left near to the top; the reason for this is to secure a clean stem free from suckers, as neither red nor white currants produce their fruit on the young wood; thus it is necessary to encourage the formation of lateral spurs along the full extension of the branches. The

young bushes are treated in much the same way as recommended in the building up of a young standard apple, that is, until a given number of branches are secured in order to make a well-balanced head; meanwhile, the laterals are kept shortened back to produce fruiting spurs (fig. 40), young shoots being occasionally admitted to take the place of old ones that may have become worn out.

It not infrequently happens that there is an overcrowding of young lateral shoots in summer, and when this is the case they should be moderately thinned early in the year. Red and white currants are often grown as cordons, espaliers, and as standards, in which case the terminal growth must be carefully attended to as regards pruning and training. The leader must be trained upright every summer and shortened back in August, the laterals being cut fairly close and never allowed to compete in growth with any of the leading branches. For example, when a young tree from the nursery is planted in its permanent quarters, each shoot should be pruned back to four buds at the base of the new wood, when at a later stage a selection must be made of those growths that give promise of forming well-balanced branches; while any inner buds not required will be better removed in order to admit as much light as possible into the centre of the tree, also to strengthen the terminal buds. At the winter pruning the leaders should be shortened back so as to leave about six or eight inches of their current season's

growth. Then, in about the month of July, the side or lateral shoots should be cut back to within three buds at the base. When the trees have attained their full dimensions only one inch or so of the main shoot need be left, while all growth extending beyond the fruit is better removed after the fruit is gathered, taking care, however, not to completely denude the whole shoot of foliage. In the treatment of cordons the leader is left entire, when in August the laterals are cut back to about three buds, in order to promote the formation of fruiting spurs along the whole extension of the stem. These spurs will demand careful attention as to thinning; otherwise they will become weakened and will bear undersized fruit.

FIG (*Ficus Carica*, Natural Order Moraceæ).

The Fig may be propagated in a variety of ways—by seeds, cuttings, suckers, and layers, and also by grafting. Propagation from seed is only resorted to when it is desired to obtain new and hardier varieties of those imported into this country from abroad, and which, although good, might still further be improved upon. As with most other pulpy fruits, the seeds must be carefully washed out as soon as the fruits have thoroughly matured, afterwards dried, and stored until January, when they should be sown in a temperature of from 70° to 75° F. From the time the seed germinates to when the first fruits are

borne, the plants must be kept steadily growing, as on the speed of growth will depend the time taken for the plants to fruit.

Cuttings of figs should consist of the previous year's wood with a heel attached whenever possible, and the nearer the growth approaches to nine inches in length the better. The cutting may be removed either in autumn or early spring; at the former time they must be heeled in the soil for winter, and adequate protection afforded when necessary to the parts unprotected above ground. The cuttings root very freely when placed around the edge of pots, and subjected to bottom heat.

If allowed to do so, figs produce suckers in abundance, and these can be removed with the roots attached; but on account of the softness of the wood of suckers this form of propagation is rarely practised, especially in view of large branches being easily layered, thereby producing strong plants which fruit in a comparatively short space of time. Where grafting is practised the scions are removed in autumn and buried in the ground throughout winter, and inserted immediately the stock shows signs of activity in spring. In view of the easy method of propagation, grafting is rarely, if ever, resorted to.

When figs are grown in the open, as for instance around Worthing in Sussex, very little pruning is done, except the regulating of the branches of young, newly planted trees, or removing those shoots which have a

tendency to grow low down close to the soil. In the case of trained trees, or where pruning is systematically performed, the operation should take place after the last of the fruit has been gathered. The fruits are produced singly or in pairs in the axils of the leaves, being formed along the branch as growth proceeds (fig. 41). Under glass the fig bears two crops, and often a third in the course of a year. The first fruits to mature are those borne on the shoots of the previous year's growth, but the success of this particular crop is only assured where the wood has become firm and well ripened. The ordinary or general crop, which is usually a heavy one, is produced on the current year's growth, while a third crop is procured from the laterals of the growths which bear the general crop. Although figs are naturally prolific and will bear regularly without any system of liberal manuring, it is never advisable to weaken the tree by allowing it to mature the later crop, and even should it do so the fruits are smaller in size, and inferior to those comprising the main crop.

When planted in the open, figs rarely ever make any growth before the month of May, at which time the embryo figs on the wood of the previous year's growth and the young shoots for the season both commence active growth. In England the second crop, or the fruits formed on the current season's growth in the open, are usually overtaken by cold or frost before they have had an

opportunity of maturing. Fruits which are advanced in size by late autumn, if only no larger than to show their fig-like form, are also worthless, and should be nipped off, as by so doing other fruits may form near to the point of their removal, and remain dormant until growth becomes active in spring.

Figs grown under any conditions require little pruning other than the thinning out of the branches, for when the knife is used too freely, there is an over-abundance of soft, unproductive wood. In summer, the pinching back of strong shoots must be attended to, leaving only those required for fruiting. The stopping of ordinary growth at the sixth or seventh leaf is sometimes practised, but it matters little whether they be allowed to extend to their full growth or not. When the first crop of figs under glass has been gathered, any weak shoots not required for filling gaps should be cut out, the remaining ones being tied in position. It is at this stage in the cultivation of the fig that the borders are manured, the plants meanwhile being syringed morning and evening. After the second crop is gathered thin surplus growths are again removed, when in winter the branches are carefully gone over, other growth being removed where not required for tying down. New shoots required to replace bare ones, or where branches have been removed or have exceeded their limits, should if possible originate near the base of the stem.

GOOSEBERRY (*Ribes grossularia*, Natural Order Grossulariaceæ).

The Gooseberry is without doubt the most useful of all bush fruits grown in the British Isles. Although capable of being grown in almost all districts, it flourishes best in the North of England, South of Scotland, in Ireland, and wherever the atmosphere is cool and moist, while the nearer the soil approaches to a retentive loam the more prolific is the growth, and the finer the quality of the fruit produced. On the shallower and drier soils, and in the warmer climate of the South of England, gooseberries are rarely grown to perfection, even when special care is taken with regard to cultural details; and to prove this one has only to compare gooseberries grown, say, in Lancashire with those grown in a county like Kent or Surrey.

The propagation of the gooseberry is effected by cuttings inserted in open ground, much in the same way as that advised for currants. Seeds are sown only when the object is to raise new varieties, so that this method is restricted to the hybridist.

In private gardens it is customary to grow all gooseberries on a clean stem, secured by removing the lower buds and leaving five or six at the extremity to form the primary branches of the bush, as is done with red and white currants. In market gardens the more erect-

growing varieties are sometimes grown on the sucker principle, the cuttings being inserted in autumn with the lower buds attached, as is customary with black currants. The object of this is that the bushes are more readily pruned by periodically removing the older wood and allowing younger growth in the form of suckers to take its place. Weeping or drooping varieties, like Lord Derby and Criterion Beauty, must necessarily be borne on fairly long clean stems or legs, so as to lessen the risk of the fruits being splashed by soil during heavy rains, this being the great drawback in allowing gooseberries to fruit from suckers. Whenever pruning drooping varieties with the object of forming or building up the foundation of the tree, it is necessary to cut to a bud pointing inwards, so that the growths of these buds assume a basin-like form.

In purchasing gooseberries from nurseries avoid plants that have been kept cut hard back for a number of years, as is sometimes practised when stocks are not readily disposed of, to keep them within reasonable bounds. When transplanted to their permanent quarters such plants rarely succeed, as they fail to make that freedom of growth which is essential in the building up of strong prolific plants. Gooseberries grafted on *Ribes aureum* are now commonly seen in many private gardens and do remarkably well when the stock is not too tall.

In whatever form gooseberries are grown, whether as

standard, bush, cordon, or fan-shaped, they invariably flower and produce fruits in abundance, but in order to obtain size and quality of fruit the ground around the trees must be kept well mulched and manured, so that as much moisture as possible is conserved for the roots.

In some districts small birds, especially sparrows and bullfinches, are so destructive to the buds of gooseberries that nothing short of enclosing the plants under a cage-work of wire netting proves effective in preserving the buds from attack. When there is little fear of the buds being stripped by birds, young bushes planted in November may have their leading branches pruned back to a well-placed bud, and the laterals spurred so as to leave three or four buds at the base (fig. 42). The object in pruning, whether it be a bush with a clean stem or one producing suckers, is to prune hard back for several years, so as to throw plenty of strength into the leading branches. The object is not to produce a profusion of small growths, but a few strong ones, the laterals along the extension of which are spurred back.

Where bushes are properly treated with regard to pruning, no difficulty is experienced in gathering the fruit, as each branch is set well apart, and there will be no such thing as one branch crossing the other. The removal of an old branch from healthy and well-established trees will always promote new growths, one or more of which must be selected to fill the place of the branch removed; in

spring they will require shortening back in order to promote the development of lateral growths, and similarly in successive years until the desired length of shoots is attained.

Where birds are troublesome it is a good plan to tie up the branches until the beginning of March, as in this way the buds will be better protected; also when pruning the growth of the remaining buds can be relied upon, as by this time the birds are attracted by other forms of diet. When fruit of exceptional quality is desired it is customary to pinch the growth beyond the fruit, as shown in fig. 43. Time does not admit of this operation being performed in market gardens, neither would it prove profitable.

MEDLAR (*Mespilus germanica*, Natural Order Rosaceæ).

The fruit of the Medlar is unfit for eating until it attains a state of partial decay termed "bleeting." The flavour may be described as astringent and somewhat acid, for which reason many people preserve the fruits in sugar in preference to eating them raw.

Propagation may take the form of seed-sowing, also of budding or grafting. Seeds are usually sown with the object of raising new varieties, or as stocks whereon to graft the choicer kinds, in which case seeds of the wild medlar are sown. Stocks other than the medlar are used

for budding and grafting purposes, including the Wild Pear, Quince, or Whitethorn. The Pear stock answers best where standards are required, grafting in this case being performed at from five to six feet from the ground. The Quince, owing to its capacity for throwing out masses of fibrous roots near to the surface, is particularly useful as a stock for moist localities. The Whitethorn, on the other hand, is especially adapted for lighter soils. In budding, a well-formed dormant bud should be used, and in grafting great care must be taken to select shoots of the previous year's growth.

The seeds are sown as soon as ripe, selecting a moist but well-drained soil for the purpose. They do not usually make their appearance above ground until the second year, which necessitates careful hoeing between the rows. The principal varieties grown are the Dutch, Nottingham, and Stoneless. The former variety assumes a very irregular habit of growth, on which account the seedlings should be trained to stakes, in order that the stem may acquire a straight, upright growth. The Nottingham has a much better habit, while the fruit, although smaller, is of good flavour. The stoneless variety finds favour merely owing to its being a better keeper than the other varieties.

A moist loamy soil is preferable to a dry soil, and if the trees are to succeed well, a somewhat sheltered position is desirable for their growth. The pruning of

the medlar consists in keeping the tree open to light and air, and in the removal of weak growths. In the Dutch variety, branches are very liable to cross and consequently rub one another, in which case they should be cut out before any damage can take place.

MULBERRY (*Morus nigra*, Natural Order Moraceæ).

The fruit of the Mulberry is often partaken of as dessert, but more frequently it is preserved or made into wine. The majority of old gardens boast at least one mulberry tree, which usually occupies a position on a lawn, where its dark foliage, as contrasted with the lighter green of the grass below, has a very pleasing effect.

The various means of propagation are by seeds, cuttings, layers, and by budding and grafting. Seeds are usually sown in the open ground early in May, having first been extracted from the ripe fruits by washing free of the pulp, followed by careful drying, and storing in a cool place. As in many other instances of seed-sowing, this method is only practised as a means of obtaining stocks for grafting. In winter, young plants are very susceptible to damage from frost, and must therefore be protected by mats or other suitable form of covering, when later in the year, towards the end of March, they can be transplanted from the seed-bed, meanwhile being shortened back to one eye.

Cuttings of well-ripened wood about one foot long and with a heel of two-year-old wood attached, will root if placed in moist porous soil and in a sheltered and somewhat shady position during early autumn, while the ground is still comparatively warm. Should autumn cuttings fail to take root, success may practically be ensured if a few cuttings are placed around the edge of a pot containing sandy loam and plunged in a hot-bed with a temperature of 65° to 70° F.; after the cuttings have rooted they should be gradually hardened off and finally planted out of doors. Layering is a very certain means of propagating the mulberry, and is frequently practised, the rooted layers being ready for removal by the middle or end of August, provided the surrounding soil has been kept moistened.

Grafting, budding, or inarching are rarely practised except for the purpose of inducing early bearing and fruitfulness in trees that produce only male blossoms. Success in grafting may be obtained by shield-budding during July and August on seedling stocks, but grafting when performed in the customary way is rarely successful, as the stock and scion bleed too freely on being cut.

The mulberry requires care in planting, and a sufficiently large hole should be dug out in order to enable the roots to spread out horizontally to their full length. Root action will be considerably encouraged if a good

mixture of old potting compost and loam be well worked in amongst the roots.

Not infrequently, the mulberry is grown as a wall tree, being afforded a southern aspect. When grown as such, it should be trained as an espalier, and kept spurred back by pinching growths made in the summer and still further shortening them in winter, care being taken to avoid overcrowding. In forming standard trees it is usual to encourage three buds as primary branches, and again shortening these to two buds each in the following year, after which they can be allowed to develop at will, so long as the centre of the tree is kept open.

FILBERTS AND COB NUTS (*Corylus Avellana*, Natural Order Corylaceæ).

Filberts are largely cultivated in Kent and other counties in the south of England, and are usually propagated by suckers or layers from the parent plant, also from seed and by grafting. Layering is performed during autumn. The leaves, when sufficiently well rooted, should be planted in nursery rows one yard wide and two feet between the rows. Suckers are detached at any time in the autumn, and also planted in rows. Grafting is practised only in rare cases, as, for example, when any particular variety is too robust on its own roots, its vitality may be checked and the tree brought into

bearing by being influenced in its root action by a less robust variety. When it is desired to raise a stock from seed, the nuts must be left on the trees until thoroughly ripe, and after gathering, placed in an airy shed. When thoroughly dried the nuts will separate from the husks, when they should be stored in sand, and planted out in autumn, except in such situations as are frequented by squirrels, rats, and mice, in which case it is better to stratify the nuts, and plant out as soon as the weather is favourable in spring.

Filberts and cob nuts may be grown in any ordinary garden soil, but they succeed best in sandy loams; on strong heavy land they make too much wood, and in consequence do not fruit freely. It is customary to plant the trees from ten to twelve feet apart each way. As growth proceeds suckers will make their appearance, and these must be kept cut back as close to the root as possible, as nothing could be more detrimental to the health and productiveness of the parent plant than an accumulation of suckers drawing sap from its roots. Standards and half standards are not planted so abundantly as in former years; dwarf bushes with clean stems not more than two feet in length being generally preferred. In exposed situations it is important that a filbert plantation be screened from east and north-east winds.

Filberts require careful pruning, and, as with other fruits, it is first of all essential to shape the tree; this is

done by cutting back the single stem of the young plant in autumn to within eighteen or twenty-four inches from the ground. If they show signs of weakness they must be allowed to grow freely for another year and then be cut close to the ground, after which one strong, straight shoot should be encouraged, and cut back in the autumn as previously advised. Of the buds which break into growth near the apex of the cut stem, select three of the best, allowing them every facility to make headway during the summer, and in the autumn shorten them back to four or five inches from their base, always cutting to an outside bud (fig. 44). In the following spring, allow two well-placed buds to grow from each of the three stems in order to form a well-balanced tree. Lateral growths must be kept in check by pinching.

Filberts, like the common hazel nut, produce two kinds of flowers—the male and the female—separately on different parts of the same tree (fig. 45). The male flowers or catkins contain a large amount of fertilising matter or pollen; they are formed in February on the upper parts of the boughs, and should be left until the tiny, plump, crimson, brush-like female flowers or nut-bearers have been fertilised. Many growers prune early in the new year, but if catkins are scarce it is advisable to delay pruning operations until the female flowers show signs of swelling, after which side branches may be shortened to the catkin, or if no catkins be present, to within three

inches from their base. Laterals terminating in a fruit-bud must not be tampered with. A certain amount of old unproductive wood may be dispensed with each year, in order to make room for a succession of young wood (fig. 44). Any suckers that make their appearance and are not required for transplanting should be severed with a spade or mattock. It is a good plan, when time admits, to break off all the stronger shoots on the upper branches during July or August in order to benefit the buds below, also to assist in the ripening of the wood. It is always better to twist or break the shoots off, as, if cut with a knife, they heal readily and soon give rise to secondary growth; whereas when broken the surplus sap very gradually exudes and prevents a growth of laterals. Trees are often spoiled by neglecting to remove central growth, which develops extensively from the main branches; this central growth should be removed systematically each summer if the tree is to be kept in hand. Good specimen trees are to be seen in Kent, many of them, although over one hundred years of age, being less than six feet from the ground; and the spreading main branches are well balanced and covered with fruiting wood.

THE PEACH (*Prunus Amygdalus persica*)

and its variety, the Nectarine, are almost identical, with the exception that the fruits of the peach are downy and

those of the nectarine smooth. In fact, true nectarines have been raised from peach stones, while peaches and nectarines are not infrequently produced on the same tree.

In temperate regions the peach cannot be cultivated to perfection in the open without being given some form of protection, that most suitable being a south wall with a glass coping. The earlier and mid-season varieties, however, will succeed on a wall with a south-west or west aspect, so as to extend the season of fruiting. In the warmer parts of Europe, Asia, Africa, and America, the peach is extensively grown and is readily propagated on Peach stocks raised from seeds. The seeds are placed under the surface of the soil during autumn, and sufficiently shallow to admit of the shells being acted upon by frost, thereby ensuring their cracking in spring and allowing the kernel to commence growth, after which they are taken up and the tender roots pinched to induce lateral branching. They are then placed in well-prepared soil in readiness for budding when the seedlings are one year old. In this country Plum stocks, to which plant the peach is closely related, are substituted for Peach stocks, and produce just that amount of hardiness and dwarfing influence which renders the peach more suited to colder climates and to soils inclined to be heavy and damp, and so endure safely in exposed positions.

The Hard-shell Almond is a good stock for very light dry soils, and whenever purchasing young trees the nature

of the stock should be ascertained. Unless soil conditions are good it is useless to attempt the cultivation of peaches in the open or under glass. They require a fairly rich and mellow soil; in fact, a typical loam of not too retentive a character, and which need not be more than 18 to 24 inches in depth, is very suitable. Should the subsoil be of a clayey or gravelly nature the trees will fail to make satisfactory growth whenever the roots begin to penetrate this undesirable stratum, and canker will make its appearance. I have seen peaches do remarkably well on walls in the counties of Surrey, Kent, and Hampshire, when the borders have been artificially made by laying several feet of transported loam over chalk; but this practice, although resulting in the production of healthy and well-ripened wood, cannot be recommended to those who regard the subject from a commercial standpoint. In Devon and Cornwall and other southern counties peaches are grown as standards, but as such the fruit is usually lacking in size, flavour, and colour; if walls are not available espaliers should be used where good quality fruit is desired.

It is a mistake to heavily manure peaches, and especially young trees, with rich fertilisers, or the raw, fresh excrements of the various farm animals, as the soil, when so treated, gives rise to a rank luxurious growth of wood, which can never be thoroughly ripened and further tends to complicate the operation of pruning. Soils manured with well-rotted or decomposed manure, and the whole

thoroughly incorporated, usually give rise to growths of medium length, which in seasons of average sunshine admit of being thoroughly ripened.

Growers of peaches under glass and in the open often go to the trouble of having the plants lifted each autumn in order that the roots may be carefully attended to; but with large trees this is a laborious operation, and few have the time or the means to carry it out; nevertheless young trees should be given this attention when deemed necessary. Where old trees under glass have shown signs of deterioration very effective and satisfactory results have attended their careful transplantation, during which operation decaying roots and branches have been removed, and the old soil replaced by a wholesome compost, composed of loam, old mortar rubble, decomposed stable manure, together with a sprinkling of basic slag or other suitable phosphatic manure.

It is not an easy matter to lay down any definite rules as to how peaches, or in fact any trees, should be trained, as, however correctly we may have the imaginary tree fixed in our mind, it is quite another matter to reproduce it in practice. Espalier trees, and particularly peaches and other stone fruits of uncertain growth, are continually being trained from the time the bud is inserted in the stock; there is no such thing as a final stage being reached, as later it is found that old branches require removal and young ones must be trained to take their

place. It is the selection and training of these younger shoots and the skilful removal of the older branches that tests the ability of the grower, as, if perfection of growth is to be attained in either a peach or a nectarine, there must be a good supply of young wood at regular distances over the extension of the whole branch, without which a full yield of best-quality fruit can never be obtained.

Provided the wood is well ripened and the weather satisfactory, pruning may take place in January, but unless these conditions prevail it will be advisable to delay the operation until February or early in March, or until such time as there is no likelihood of damage from frost. In the case of peaches under glass, pruning is best performed about the middle of November. The extent to which the various shoots should be shortened will depend upon a variety of circumstances, all of which must be carefully considered on their respective merits. Shoots are often damaged by frost, or the fact of their being cankered or mildewed may demand their whole or partial removal, while those healthy shoots from which it is desired to procure fruit, or to obtain strong wood growth for the purpose of filling up bare spaces, must be shortened accordingly.

Wherever shortening is performed, this must be done to a wood-bud and not to a fruit-bud, as *illustrated* in fig. 46. Wood-buds are not so readily detected in autumn- as in spring-pruning. Close examination, how-

ever, will show that the wood-buds are rather long and flat with a tapering point, whereas the flower-buds are plump and rounded and stand out from the branch much more than do the wood-buds.

This shortening or cutting back of shoots is extremely important in the case of young trees, as, should long strong growths be tied or laid to their full length during successive years, the lower portion and centre of the tree would become thin and totally devoid of shoots, and any attempt at amputation or cutting back of these stronger branches at a later stage would result in the excretion of gum, followed by canker and in all probability the death of the tree. If the shortening is done when the tree is young, no such disastrous results need be feared, and an abundance of young growths will always be available for keeping up a supply of fruit. Some growers insist on leaving the shoots of young trees at their full length, arguing that the buds break naturally all along the extension of the branch. While this is quite true in the majority of cases, and while I agree also that considerably more, and often better quality, fruit is obtained by this practice, the drawback is that to which I have already referred, namely, that the tree does not fill out well at the bottom, and in consequence there is a lack of wood for future use, so that what little is gained in the first few years of the tree's growth is more than lost during the twenty or more years that it is

in full bearing, and should cover all the available wall-space possible.

The dis-budding or summer pruning of the peach constitutes a very important operation, commencing in May and continuing as late as September. Dis-budding is restricted to the removal by the rubbing off of all buds not required for development, such as fore-right shoots, together with those produced from the backs of the branches, similarly ill-placed (fig. 46).

It is a mistake to nail or tie in an over-abundance of young wood, as the greater portion of it will require to be cut out in the following spring. If we examine a young tree it will be observed that buds grow rapidly on the young branches which have been cut back. As soon as these have attained a length of from a quarter to half an inch dis-budding may be proceeded with. The bud at the base of the growth must be preserved, as also must the terminal bud, while along its extension and between the apical and basal bud three other buds or shoots must be left on the upper side and at regular intervals from one another. In from ten to fourteen days two of these three intermediate growths can be removed, leaving but one shoot or growth about midway between the terminal and basal buds. If more than this number of growths are left they only tend to crowd the tree and restrict the circulation of light and air. Young trees, which show a tendency to make a superabundance of strong growths, should be

allowed to bear a fair number of fruits as a means of restricting growth (fig. 47). To ensure the setting of the fruit the blossom-buds that appear here and there along the branches should, when fully open, be assisted in their fertilisation by distributing the dry pollen over the stigmas with the end of a hare's tail or fine hair brush. It is usual to allow more fruits to set than are actually required, as some drop off when stoning; otherwise, judicious thinning will be necessary.

PEAR (*Pyrus communis*, Natural Order Rosaceæ).

The propagation of the Pear may be effected by seed, layers, also by grafting and budding. Seed-sowing is mainly restricted to the raising of new varieties or to obtain the requisite number of stocks for budding or grafting upon.

In raising new varieties, seed should be carefully selected from the best developed fruits, which must also be quite free from disease of any kind. A common practice is to sow the seeds thinly (fifteen to twenty) in large pots sufficiently drained to prevent stagnation, in a sheltered position out of doors, and placed on bricks or other suitable material capable of resisting the attacks of worms and snails. A piece of slate or thick glass should also be placed over the surface of the pot as a further means of protection.

In spring the seedlings will make their appearance, when in due course they should be potted off, although no serious harm will result from keeping them in the pots until they are twelve months old, during which time it is not unusual to find some of the seedlings making their appearance at a much later date than others sown at the same time.

Seeds sown for the purpose of raising stocks are best scattered in shallow drills about one foot apart, either in spring or early autumn, the seed-bed being first trenched or deeply dug. When twelve months old the seedlings may be transplanted into nursery rows, and when large enough, to their permanent quarters; seedlings thus treated will commence fruiting about the seventh year, although there are numerous exceptions according to variety and subsequent treatment as regards root-pruning.

The propagation of pears by cuttings or layering is very rarely practised except where it is necessary to retain some particular variety until such time as it can be grafted.

The principal means of increase is by budding or grafting, the former operation being best performed by inserting a bud under the young bark in July or August, and the latter in March or April, according to the condition of the sap. Whip or tongue grafting is the form usually practised, although cleft and crown grafting may prove equally successful if skilfully performed; but whatever system is adopted the buds of the graft should be in

as dormant a condition as possible, their growth being retarded by removal from the tree in January and being heeled or buried in cold ground where the sun has little effect on the temperature.

The stocks on which pears are usually worked are the Common Pear, Quince, and, in somewhat rare cases, on the Whitethorn, Hawthorn, Mountain Ash, and the Medlar. Quince stocks are so easily raised from cuttings that there is little need for sowing seed; and even where the natural condition of the soil is not favourable to root action, layering may be resorted to with certain success.

The Pear stock is naturally possessed of a robust and healthy constitution, for which reason it is not suited to all soils, as its vigorous growth, particularly in deep loamy soil, favours the development of luxuriant or gross wood, which subsequently prohibits early fruiting—a condition which is responsible for the old adage, "To plant pears for your heirs." The contact of the strong roots of the Pear stock with strata of gravel or cold wet clays are reasons for the decay and disease of relatively strong branches before they have attained a state of maturity. When arrested by a chalk subsoil the roots of the Pear remain healthy and receive just that amount of check necessary to induce early fruiting, which always accompanies maturity, or, in other words, a less active flow of sap throughout the tree. The Quince stock (fig. 48), on the other hand, is fibrous rooting, and therefore a surface

feeder, and capable of being kept more under control, for which reason it may be planted on light gravelly soils, in heavy loams, or even in damp situations, the amount of success depending on the attention given to the encouragement of surface roots. The effect of this mass of fibrous roots is to dwarf the tree and thereby favour early maturity.

When grafting on the Quince the stock should be headed down close to the ground, as the wood of the Quince does not enlarge in proportion to that of the Pear, so that any portion of the Quince appearing above ground as stem is not only unsightly but useless. A process of double grafting is frequently practised when using the Quince as a stock for standard Pears; it is also the only effective means of attaining fertility in some of the better-known varieties. In the formation of standards, a vigorous variety is selected for the stem, which at the required height from the ground is cut off, and a graft of the required sort inserted.

Whenever grafting on the Quince, it is essential to head the young stock back early in the year, not later than the end of February, as, if left to the time of grafting, before cutting down, it will be found that much of the sap will have become expended, and in consequence of this the buds of the scion will be badly nourished. Double grafting on the Quince does not suit all varieties of pears, and there is much room for investigation in this direction.

When planting pears the character of the stock must be taken into consideration, although for both the Pear and the Quince stock a deep loamy soil with a well-drained subsoil cannot be improved upon. Heavy clayey soils are not conducive to fertility, and before planting in such they should first be improved by the admixture of brick rubble, old potting compost, or other suitable material capable of increasing porosity and imparting a higher temperature to the soil. On shallow soils, and those of a light, sandy nature, it is preferable that the majority of varieties should be on the Quince stock, and although the life of the tree is shortened, early fruiting is ensured, and in many cases the trees are apt to be over-cropped. If this is allowed, it usually results in a severe check to the tree, thus throwing it into a weak condition of growth, from which it may never recover. Choice dessert varieties of pears should be given a south wall, whereas those for later use may be grown in the open as bushes, pyramids, espaliers, etc. This method of placing in the ground is similar to that recommended in planting apples; allow plenty of room for the roots to be spread horizontally, and avoid deep planting, especially where the quality of the subsoil is of a doubtful character. Always see that trees on the Quince stock are planted below the union of the stock and scion. In soils of a dry nature the Pear stock is often preferable to the Quince, because it roots deeply and gives a longer

life to the tree, and at the same time is not conducive to barrenness.

Trees grafted on the Quince require careful attention during seasons of drought. The roots, being fibrous and close to the surface, readily suffer for lack of moisture. Therefore liberal mulchings of retentive manure should be given in the early spring, and occasionally heavy waterings are necessary. It is next to useless to plant pears in low-lying districts where late frosts are prevalent; though the trees may blossom freely and even set their fruit, one night's frost may render the whole of the tree unfruitful.

Pears vary considerably as regards the methods of pruning which should be adopted. Standards are treated in the same manner as advised for apples, that is, in keeping the head of the tree well balanced, open to light and air, and free from irregular and weak growths. Bush trees are soon induced to assume a good shape, but pyramids, espaliers, cordons, and other trees having their main branches at regular intervals from one another, call for special attention, which, however, may be summed up in the careful extension of the principal branches and the judicious regulation of all laterals, so that under no circumstances whatsoever are they allowed to compete in growth with the main branches of the tree.

The pruning of spurs requires annual attention, as they gradually become further removed from the leading

branches of the tree, in consequence of which the fruit is of inferior size and may suffer also in flavour. It will be observed that an average spur is composed of wood-, leaf-, and fruit-buds (fig. 49), which, if not checked, the wood- and leaf-buds increase in number at the expense of the blossom-buds. To avoid this, they must be cut off comparatively close on the upper branches of the tree, and less severely in descending to the lower branches, the object being to induce a greater flow of sap to the lower buds, which are usually weak, owing to the elaboration of sap in the production of an excess of wood growth in the higher branches.

Of late years it has been proved that many varieties of pears, formerly given a warm wall, have fruited equally well in the open, provided that soil and climatic conditions were favourable.

Many amateurs, when they purchase a young well-trained tree from the nurseryman, neglect to make a study of its growth and the method adopted in training it up to the time of purchase, with the result that when it becomes established and makes a luxuriance of growth it very soon gets out of all bounds. To continue the training of an espalier, as shown in fig. 33, it is necessary in winter to shorten the main branch to within a foot or so of the last pair of branches. In the following spring allow the terminal bud and a well-placed bud on either side, and just below the terminal bud, to break. These

three buds will produce growth which in turn must receive similar treatment at the winter pruning, and so by gradual stages the wall space becomes filled. The side or lateral branches must be sufficiently shortened back at the winter pruning to admit of the buds at the base and along the extension of the branch developing into fruiting spurs, only the terminal bud being allowed to extend.

Excessive winter pruning can be almost entirely disposed of if laterals of strong growth are pinched out or stopped in spring, also if buds occupying useless positions, or crowding the spurs, are rubbed off before they develop. Where too numerous, blossom-buds may with advantage be similarly treated. Wood-buds are abundant around the base of many fruit-spurs, and these should be disbudded so as to allow two or three to develop at distances of from six to eight inches along the branch. When fully grown, say in July, these shoots should then be shortened back to within five or six buds at each base, except where required to fill up a vacant space, in which case they must be left intact until winter. Any subsequent shoots that form may be pinched at about the fourth leaf. The advantages of this disbudding and stopping of growth are manifold: it admits of more nourishment being given to the development of the fruit-buds, and also admits of more air and sunlight surrounding the foliage and fruit, thereby making it less liable to fungoid and insect attacks.

Lateral branches intended for extension should always

be allowed to grow in a perpendicular position as far as possible, during spring, and, in fact, until shortened back in winter, for if they are tied down to a horizontal position the coarse sap is often reverted into a young wood growth on the upper side of the branch. And if this is unobserved it very soon takes a lead, with the result that the terminal growth is starved into developing fruit, or may even die back. As both terminal and lateral branches required for extension will assume very considerable lengths, it is necessary to tie them to stakes, or in such a way as will prevent all risk of their becoming damaged or broken by wind.

Fig. 50 represents a leading shoot at the apex of which a fruit often forms due to the presence of a fruit-bud; this must never be allowed where such branches are required for extension purposes. If the pruner took more care to distinguish between a flower- and wood-bud this need not happen.

PLUMS (*Prunus domestica*, Natural Order Rosaceæ).

While some varieties of Plums are propagated from seed, the usual method of increase is by budding on seedling stocks of the Wild Sloe and Bullace, also on Mussel, Brompton, Brussels, Black Damask, St Julian, and other plums. The stones may be either stratified until spring, or sown as soon as ripe in autumn.

In the autumn of the first year the seedlings will be ready for transplanting into nursery rows, at which operation the tap-roots should be shortened, when in the second year they should be cut down to two buds above the surface, one bud only being allowed to form the stem where the tree is destined to become a standard. All gross growths must be checked by lifting and root-pruning, otherwise the tree will become barren. The Greengage, and also the Damson, usually reproduce themselves more or less perfectly from the stone, yet on the whole it is more satisfactory to resort to either budding or grafting. The majority of growers prefer budding to grafting, because it can be performed at a less busy season of the year, as in the spring so many important operations require attention; also it is more usual to resort to grafting in the case of apples and pears.

When preparing to graft plums, it is important to see that the scions are taken off early in the season before the buds show any signs of development; at the same time, the stocks should be headed back in order to check any undue elaboration of sap at the extremities of the branches. Young stocks should be worked as close to the surface of the ground as possible, and during a season of drought it is a good plan to draw the surrounding soil up over the joint, more particularly when the protective substance is composed of clay.

Plums should be planted as advised for apples, the ground having received a thorough trenching. As regards space, from 20 to 25 feet between the rows and 20 feet between the trees in the rows will suffice; but if arranged in the quincunx system, the distance between the rows should be 24 feet, when the trees in the rows will be approximately 20 feet 9 inches apart.

After planting it is important that the roots of plum trees do not become dry and parched, and to prevent this happening the roots should be mulched during drought in order to conserve moisture. The roots of carefully planted trees retain their position near to the surface, and for this reason the ground surrounding the trees must be carefully treated, and if regularly cultivated should be dug one spit deep at least once a year.

Many varieties of plums, when grafted on stocks raised from suckers, are continually throwing up suckers at varying distances from the centre of the tree; when sufficiently well developed, these suckers should be laid bare and cut off as close as is possible at their junction with the root.

In the formation of a standard tree the same method of pruning is followed as advised for standard apples and pears, that is, from six to nine leading branches are developed at regular distances from each other, after which all that is necessary is to check strong lateral growths, and to remove all shoots that have a tendency

to grow cross-wise and so rub against other branches. A three-year-old trained tree intended to cover a wall will usually have six branches, at the extremities of which two or more shoots should be encouraged on the upper sides, so that a foundation may be built up as soon as possible. In the following year, similar treatment is given and continued until the allotted space is filled up. In order to produce a symmetrical tree all shoots, as far as is practicable, should emanate from the upper sides of the branches.

It will be noticed that apart from the ordinary fruiting spurs, plums produce spine-like growths several inches in length; these in due course will develop into fruiting spurs, and it is immaterial whether they be shortened back or merely left to develop at their own free will. In winter fruit-spurs which form along the whole length of the main branches of the tree must be carefully examined, and the shoots of the previous year's growth shortened to within a few buds of their bases; while any strong growth must be cut back to within two to four buds of the stem, according to strength. The weaker the shoot the closer it must be shortened. The fruit spurs soon become extended and irregular in form, and must accordingly be thinned, or, where they are too close together, a spur here and there may be removed altogether (fig. 51). Disbudding in spring and early summer will do much to minimise winter pruning, although rarely is

it necessary to disbud plums to any great extent. Strong lateral shoots are best treated by shortening to half their length, while the shoots which make their appearance at a later stage should be pinched back at the second leaf, when no further attention is necessary until the winter pruning, when the whole spur will be regulated and shortened as already described.

In trained trees the extension shoots must be looked after and encouraged, and where produced out of position they must be pinched off young; in bush trees no hard-and-fast system of pruning should be indulged in, so long as the trees are open to abundance of light and air. The shortening back of branches and close cutting of spurs—in fact, any form of excessive pruning of plums with a knife or hand-saw—tends to encourage gumming, which is always more or less injurious to the health of the tree. Plums, like other stone fruits, are best checked of excessive sap and brought into bearing by careful lifting and replanting.

The fact that the plum is a surface feeder is often lost sight of, and there can be little doubt that the unfruitfulness of plum trees in many gardens is not altogether due to imperfect soil conditions, but more directly to neglect of root-pruning. Pyramid, cordon, and bush trees require to be lifted and very carefully root-pruned every alternate year, and before the trees shed their leaves; otherwise the growth becomes very crowded and gross.

Young trees in certain seasons are unusually prolific, and when so the fruit should be liberally thinned when it is from half to three parts grown. In the case of trees on walls, or where fruit of good size and quality is desired, thinning should take place when the fruits have set and are just beginning to swell.

RASPBERRY (*Rubus idæus*, Natural Order Rosaceæ).

The usual method of propagating the Raspberry is by suckers, which are produced freely from the original plant or cane. It is very rarely that plants are raised from cuttings, and seeds are sown only when it is desired to raise new varieties. Where raspberries are growing freely, as is usually the case in deep alluvial soils, numerous suckers will be found at some distance from the old stools; these suckers or offsets are generally well furnished with fibrous roots, a point to be observed in the selection of canes for planting; a slim medium-sized cane with a mass of fibrous roots is preferable to a stout cane having but few roots at its base.

Before planting raspberries the ground should be thoroughly trenched and cleared of all weeds, the convolvulus or "lily root" in particular. The plants are usually set out in rows about five feet apart and three feet from plant to plant, according to the fertility and retentiveness of the soil. As raspberries are shallow rooting plants, and

form a mass of fibrous roots close to the surface of the ground, it is a fatal mistake to dig deeply between the rows after the plants have once become established. The best month for planting is October, as the plants have then an opportunity of establishing themselves before winter sets in. To further induce root action, the newly planted canes or suckers are cut back from six to twelve inches from the ground according to their strength. In the following spring, shoots are produced from the roots of the young plants, which are destined to bear fruit in the following year. When the plants have become thoroughly established it is customary to cut out all the old fruiting canes in the autumn, by which time the sap contained in them will have returned to the basal buds under ground; at the same time the young canes which are still extending their growth must be thinned judiciously, and where not in continuous rows, from five to six canes to each plant will prove ample (fig. 52). In winter pruning, it is an excellent plan to shorten the canes to 3½ or 3 feet, as in this way they do not require supports, and at the same time a heavy crop of excellent fruit can be relied upon.

Autumn-fruiting raspberries, like Perpetual de Billard (Belle de Fontenay), bear their fruit underneath the foliage at the top of the summer shoots. It is advisable to cut the canes of these kinds close to the ground in February or early in March, and when the new suckers are produced, to thin them out sufficiently to afford ample space to each.

Should a gross sucker appear here and there, it should be removed, as, in addition to weakening the others, it will continue growing late in the year and so prove fruitless. The fruits of this and other autumn varieties are borne underneath the foliage, as mentioned above; thus the tops of these summer shoots are better removed; in fact, the more light and air the less liable are the fruits to become mildewed during the dull, damp days of late autumn.

THE GRAPE VINE (*Vitis vinifera*, Natural Order Ampelideæ).

The propagation of the Vine is effected by seeds, cuttings, layers, and grafting, the practice of inserting a cutting of the stem with an eye or bud attached being the most common, as shown in fig. 8. The best time of the year to prepare the cuttings is in January, just previous to the buds swelling; thus when placed in contact with the soil or other rooting medium, growth soon becomes active, in consequence of which roots are readily developed. Eyes or buds must only be taken from firm, well-ripened wood with a heel attached, and placed singly in thumb-pots containing a compost of friable loam, leaf-mould, and sand, the pots being first of all filled and the buds pressed into the soil with the finger and thumb. If plunged in a propagating frame of cocoanut fibre having a bottom temperature of between 70° and 80° F., and kept moist,

roots will be freely emitted. When several leaves have formed on the now developed shoot, and the pot is well filled with roots, a shift into a larger pot will be necessary, and later again, as growth proceeds; meanwhile the temperature must be maintained at not less than 80° F. during the day and 75° F. throughout the night. Towards autumn the temperature may be gradually reduced to 70° F. by day and 60° F. at night, accompanied by abundance of light and air so long as this temperature is maintained. Layering is often practised as a means of propagating vines that are grown in the open; it is accomplished by taking eight-inch pots filled with good mould and sinking them into the ground, then twisting the shoot of the vine until it splits, afterwards pegging this portion of the stem in the pot. When rooted, the layer is shortened back to two eyes, which in spring make a rapid growth and require staking; later, however, the terminal shoot can be dispensed with, leaving the lower shoot only, which, when it has reached a length of about six feet, should be stopped. When grafting is employed, whip-grafting will be found to answer best.

From the middle of October to the middle of November is the best season of the year at which to plant vines in the open, failing which time it is advisable to postpone the operation until spring, or just previous to the sap rising. Given a warm situation, vines will succeed in any soil of medium consistency, provided it is well drained.

Light sandy soils and those of inferior quality must be improved by the admixture of substantial turfy loam, if possible from a heap that has been stored with alternate layers of cow manure. In planting the roots must be carefully spread out, the soil being well filled in and packed firmly around them, after which the surrounding earth must be well watered and the surface mulched.

When planting vines under glass, the beds for the reception of the roots must be carefully made, and in such a way that there is no risk of stagnation at the roots due to a waterlogged condition of the soil. Thorough drainage is essential, and to prevent the roots penetrating into the cold uncultivated soil below the bed, it is advisable to well ram the bottom with chalk, this being preferable to concrete or paving with stones. The very best fibrous turf obtainable must be used if good results are to be ensured, and should be broken into coarse lumps and mixed with a liberal sprinkling of well-decomposed farmyard manure, brick rubble, bone meal, and coarse sand. A compost having a tendency to form a pulpy mass when watered should never be used for vines.

Many cultivators possessing expert knowledge and experience affirm that spur-pruning is to be preferred to any other method of cutting, and indeed it may be assumed that this is the most common form of pruning which is practised. Young vines when first planted should be cut back to within three or four eyes from the ground; from

this stage onwards, their growth should receive every encouragement in order to produce an abundance of foliage. As the young shoot or rod extends in growth it is sometimes advisable to pinch out the tip, or extremity, which has the effect of thickening the stem; as an alternative to this method some growers prefer to shorten back the rod or cane one-third of its length as soon as growth for the season has ceased. Similar treatment is adopted in the second and also in the third year, should the stem not attain to the required thickness. Lateral shoots that are forced into growth by cutting back, or otherwise checking the terminal growth, are pinched close to the main stem.

Several bunches of fruit may be allowed on a two-year-old rod, but it is fatal to overcrop young vines until the wood has become thoroughly matured and ripened. In selecting the permanent lateral buds on a rod, they should be arranged alternately on each side at an average distance of nine inches apart. At the end of each autumn the laterals will have become well ripened by exposure to sun and air, and they should be shortened back to one bud close to the rod (figs. 53 and 54). If deemed preferable to leave two buds, as is sometimes done as a security, care must be taken to finally select one bud immediately they commence to grow in spring, the disqualified bud being at once removed. As the remaining bud develops its growth, a bunch of blossom destined to form fruit makes its appearance at the second

leaf, and opposite to it a shoot will probably break into growth; while at the third leaf a tendril is developed; also a growth on the opposite side similar to the one already referred to. Other bunches, growths, and tendrils will form as the lateral extends, but the object of the cultivator is first to encourage a well-developed bud in the axil of the first leaf, which alone can be accomplished by the healthy development of the leaf itself; secondly, to select the best-formed bunch; and lastly, to pinch or snap off each sub-lateral to the first leaf and the lateral bearing the fruit to the first or second leaf beyond the bunch. It is thus seen that the system of pruning adopted is one of disbudding, stopping, and spurring back of growths both primary and secondary (fig. 55).

When vines exhibit exceptional vigour the strongest laterals may be allowed to carry two bunches without in any way injuring the future productiveness of the vine Strong laterals restricted to one bunch frequently prove troublesome, the otherwise dormant buds bursting and giving rise to a superabundance of laterals.

Where vines are grown in the open it is usual to cut the canes close to the ground at the fall of the leaf, leaving only two or three buds of the current year's growth. The primary object of this severe pruning is to keep the stools dwarf, and to afford the canes all the radiated heat available. When the bunches are showing in spring, disbudding is commenced; three to four shoots being left on a plant.

LEMON (*Citrus Limonum*, Natural Order Rutaceæ).

Lemons, like oranges and plants of the same family, are propagated by seeds, cuttings, layers, budding, and grafting, the budding being usually the method of increase adopted. Stocks are obtained by sowing pips or seeds of the commoner varieties. In this country the lemon and orange are grown in greenhouses as evergreen shrubs or trees, and, where sufficient accommodation can be afforded, they flower and bear fruit freely. The seedlings intended as stocks for budding are raised on hotbeds and are gradually hardened off, when in July or August of the following year they are grafted, and again placed in the propagating frame or under bell glasses for from four to six weeks, by the end of which time it will be seen whether the buds have taken or not. If successful, the plants are wintered in the greenhouse, and in the spring they are headed back to within several inches from the bud, and again placed in heat in order to encourage the growth of the bud, which, should the stock be vigorous, will make growths several feet long by autumn.

Both lemons and oranges thrive well when planted out in well-drained beds filled to a depth of two feet with a compost of good fibrous loam, leaf mould, mortar rubbish, and sand. If bottom heat can be provided this will add considerably to the healthy growth of the trees.

Lemons and oranges require little pruning other than

is necessary to keep the trees well balanced and open to light and air. It frequently happens that in robust, healthy trees, strong shoots are developed, and if not checked by pinching when young, they very readily rob the weaker branches of nutriment. Plants grown under glass often become long or leggy instead of broadening out, a condition which can often be traced to neglect in shortening back young woody growths. This defect can be remedied by cutting the plants fairly hard back in spring and plunging them in beds of cocoanut fibre, keeping the house moist and close at a temperature of from 75° to 80° F., which gradually lower and admit more air to harden the plants as growth proceeds.

ORANGE (*Citrus aurantium*, Natural Order Rutaceæ).

Oranges are not grown to the extent in English gardens as they were some hundred or so years ago, when any garden of pretence could boast of its orangery; nor is this to be wondered at seeing that imported fruits have attained so great a degree of excellence. As a greenhouse plant, oranges are, however, grown for decorative purposes rather than for dessert. Propagation may be effected by seeds, layers, cuttings, or by grafting and budding. The object of sowing seed is usually for the purpose of obtaining stocks for grafting or budding.

The seeds or "pips" may be sown in boxes of ordinary

soil placed on hotbeds or in propagating frames at a temperature of from 65° to 75° F., when in the course of five or six weeks they will be ready for potting off singly into thumb-pots. They are then placed in a temperature of from 70° to 75° F., and kept shaded until root action has been re-established, after which they should be gradually hardened off. As the plants are somewhat slow in making growth, they will not be strong enough for budding until the following year, when the latter end of July or August will prove the best time. After budding, place the plants under a bell glass or in a frame, and keep carefully ventilated after the first few days, when in the course of a month or so it will be possible to see if the buds have taken, as will be denoted by their beginning to swell, and when the tying material must be removed, and the plants gradually hardened, and finally allowed to remain in a moderately cool house throughout the winter. Before active growth commences in spring, the plants will require to be headed back to within several inches from the buds, again placed in a close warm temperature to excite growth, and again hardened by degrees. If strong vigorous seedlings were used as stocks, the plants will now have produced growths several feet long.

Oranges delight in a good friable soil which for trees of large growth will require enriching with well-rotted manure. The addition of sand and fibrous peat is also

useful in keeping the compost more open and porous. Conditions tending towards excessive cold and moisture at the roots must be avoided, as such inevitably produce ill effects, often betokened by the foliage turning yellow, and to remedy this bottom heat should be applied where practicable.

Little pruning is required beyond the regulation and thinning out of branches, except in sickly trees, when the ends of branches showing signs of withering should be topped off. Similar treatment should also be given to the corresponding roots in the event of the tree being lifted, which operation is usually deemed essential in such cases.

WALNUT (*Juglans regia*, Natural Order Juglandaceæ).

The Walnut is propagated by seeds, also by budding and grafting. If grown for timber the seeds are best sown in the position they are to occupy, as on germination they develop a strong tap-root which, when severed in the operation of transplanting, considerably checks the growth of the young tree.

As it is not always convenient to sow the seeds in their permanent quarters, they must then be first sown in nursery rows, after having been stratified for the winter. The seed-beds should first be trenched and the drills drawn about two feet apart as soon as the ground dries off early in March. Transplanting may be proceeded with in

the autumn, and if not then it should never be deferred if possible after the second year.

Grafting is successfully performed while the sap is active, whip- and cleft-grafting being preferable to other methods. Ring-budding and shield-budding can be equally well relied upon as a means of increase if practised when the sap circulates freely.

Ordinary care is required in planting, the ground first being deeply trenched, after which a sufficiently large hole is made to receive the roots with the ball of earth attached. Pruning consists in shortening back the graft just previous to its breaking into growth in spring, and treating the laterals thus developed in a similar manner, and at the same period in the following year. When grown in the open the tree naturally develops a well-balanced head necessitating little or no pruning other than to keep cross branches cut out, and to remove any damaged or decaying limbs.

It is inadvisable to plant walnuts in close proximity to fruit trees, more especially wall trees, as the roots of the walnut extend to considerable distances just below the surface of the ground in search of food. I am acquainted with some fine handsome walnut trees bordering a churchyard, and which have never been known to fruit, due to their luxuriance of growth, the reason for which may not be difficult of solution.

HARDY DECIDUOUS TREES

ASH (*Fraxinus excelsior*, Natural Order Oleaceæ).

The Ash is usually propagated by seeds, but many varieties are increased by budding and grafting on stocks of the same species. After gathering in the autumn, it is customary to store the seeds for eighteen months in order to ensure their speedy germination when sown; they are best stored in dry sifted earth or sand, which medium assists the rotting of the outer coat. Heating of the heap must be prevented by turning occasionally, also by avoiding too great a depth of soil containing the seeds.

In the second spring after storing, the seeds should be sown thinly in nursery rows, when in the following year they should be transplanted into rows fifteen inches apart and six inches from plant to plant in the rows. In the third year they may be transplanted to their permanent quarters.

As an ornamental tree the ash succeeds in a rich loamy soil. There are many varieties, some of which have variegated foliage, and some of which have pendulous branches. In the cultivation of ash for timber, a rather low-lying situation is to be preferred, provided the soil is not charged with excessive moisture of a stagnant character.

BEECH (*Fagus sylvatica*, Natural Order Cupuliferæ).

The Beech is largely propagated by seeds or nuts, which are gathered when they fall to the ground in autumn. They are then treated similarly to the seeds of the ash, except that they are sown in the following March instead of being kept for an additional year. The seed bed should be composed of light soil, and the seeds are best sown thinly in rows and covered with a very light covering of soil not exceeding, if possible, three-fourths of an inch. At the end of the second year, the seedlings can be transplanted into rows about eighteen inches apart, and from four to six inches from plant to plant in the rows. In exposed situations, it will be necessary to afford some means of protection until the young plants get established.

Beeches may be found growing on a variety of soils, but they are never seen to greater perfection than when growing on rich light loams overlying the chalk, conditions which exist but within two miles from where these words are being written, viz., in Hackwood Park, where many of the beeches have clear straight stems over fifty feet in height.

In planting large trees, care must be taken not to injure the roots more than is absolutely necessary, and under no conditions must pruning of the branches be resorted to until the trees have become well established in

their permanent quarters. As growth proceeds, it is often found that a certain amount of pruning must be resorted to in order to maintain a regularity of growth between the roots and the branches, and this is best performed by shortening back the leading shoots, meanwhile preserving the lateral branches intact, as their value to the healthy development of the tree lies in the amount of shade they impart to the ground below, in keeping it cool and moist, a condition favourable to the extension of the roots, which in the beech are not far removed from the surface of the ground. The copper beech (*F. s. atropurpurea*) has met with much favour as an ornamental tree, handsome specimens of which are to be seen in many private gardens, and in public parks.

BIRCH (*Betula alba*, Natural Order Cupuliferæ).

The trees of this genus are renowned for their graceful habit, combined with beauty of foliage and stem, the white and reddish colouring of the bark in matured trees being particularly handsome.

Propagation is usually effected by seeds, the varieties being grafted. Seeds are gathered in autumn, and then stored throughout the winter and sown in March on seed beds of an average width of three and a half feet. The finer the tilth that can be obtained the better will germination be assisted, and under no circumstances must the seed be

buried deeply, a mere covering of earth to exclude light being all that is required. When one year old, the seedlings should be transplanted to nursery rows, where they may be allowed to remain before transplanting to their permanent quarters. The birches adapt themselves to almost any kind of soil, but for preference they delight in a rich sandy loam. The dwarf kinds may be propagated by layering in the autumn. The numerous varieties, some of which are extremely handsome, are increased by budding or grafting on seedling stocks of the commoner kinds.

ELM (*Ulmus campestris*, Natural Order Ulmaceæ).

The Elm may be propagated from seed, layers, suckers, or by grafting and budding. The seeds seldom ripen in this country, and therefore have to be imported, as even where the elm is indigenous the seeds have a low germinating capacity, which becomes still lower after they have been subjected to storage and transit, and it is for this reason that other methods of propagation are resorted to.

Layering is usually performed in autumn, so that the layers may have an opportunity of rooting before the ground becomes too cold and wet. The method usually adopted in layering is to plant young plants about five feet apart, when they are allowed to remain for two or more years until well rooted; then they are cut over similar to the heading back of a bed of osiers to within

three or four buds from the ground. In the autumn the shoots produced from the buds are bent down and pegged at regular intervals around the stool, the surrounding ground having first been carefully forked over and freed of all troublesome weeds and other rubbish likely to detract from the healthy development of the layers.

In the following autumn the layered plants will be fit for transplanting to the nursery rows, when after being severed from the parent plant a succession of young shoots for layering will push forth from the cut parts of the stems below ground. In some varieties of elm, suckers are freely produced and afford a ready means of propagation. When grafting is resorted to, the stocks are cut back close to the ground, the grafts being inserted as close as possible to the roots, which, if well established, throw strong shoots in the first year from three to five feet in length.

HORNBEAM (*Carpinus betulus*, Natural Order Corylaceæ).

The Hornbeam is propagated from seeds sown in autumn or early spring. Very often some of the seeds do not germinate until the second year, but should the rows be crowded owing to the greater percentage of the seeds germinating in the first year, then they must be transplanted in the autumn of the first year. If thin on the ground, however, they may be left undisturbed until the

second year. In transplanting the roots must be shortened back so as to encourage the formation of fibrous roots. Hornbeam makes a good hedge, and withstands pruning.

LIME (*Tilia europæa*, Natural Order Tiliaceæ).

Propagation of the Lime is usually effected by layering during autumn and winter, and, provided the soil is fairly moist, strongly rooted plants will be fit for transplanting at the end of the following year. Seeds are usually imported from the Continent where they ripen perfectly. They should be sown as soon as received, as if preserved dry until the following spring they germinate irregularly, many of them remaining dormant until the second year. A general practice is to mix the seeds with sand or finely sifted earth, just sufficiently moist to retain the natural condition of the seed and prevent injury from contact with dry air. In this way the seed may be kept until spring, when germination will proceed regularly. Occasionally well-matured seed is sown in autumn in drills eight inches apart, and covered with one-half to three-fourths of an inch of fine earth, in which case it is necessary to cover up the beds in spring to protect the seeds from early germination and simultaneous injury from frost. After the seedlings are transplanted to the nursery beds they require to be trimmed from time to time, as they often show a tendency towards excessive lateral development.

LIQUIDAMBAR (*Liquidambar styraciflua*, Natural Order Altingiaceæ).

L. styraciflua, or Sweet Gum, is readily increased by layers, removed at the end of the first autumn following their formation. Imported seeds are often sown, but if allowed to remain in the catkins until sowing time, they will take a year in which to germinate.

MAPLE (*Acer campestre*, Natural Order Sapindaceæ).

The commoner species and varieties of Maple are readily increased from seeds, sown either in autumn or spring, in a moist retentive seed-bed, taking care not to bury the seeds deeper than a quarter of an inch. The rarer and more delicate sorts should be sown in frames. Layering is also practicable, while some of the rarer species and varieties, more especially the variegated kinds, are grafted or budded on those of more robust habit of growth.

OAK (*Quercus robur*, Natural Order Cupuliferæ).

The Oak is readily propagated from seeds sown during autumn; the ease with which germination takes place is seen by the manner in which seedlings spring up in the vicinity of oak trees. The variegated and other forms of the common oak are reproduced by grafting.

MOUNTAIN ASH (*Pyrus aucuparia*, Natural Order Rosaceæ).

P. aucuparia and many other species and varieties are readily raised from seeds, while those of weaker habit of growth are propagated by budding or grafting on other species. *P. communis* (Wild Pear) and *P. Malus* (Wild Apple) are among the more prominent species of the order.

PLANTANUS (*Plantanus occidentalis* (American Plane Tree), Natural Order Plantanaceæ).

P. occidentalis and *P. orientalis* may be propagated by layers from seeds. The seeds are contained in round balls which should be broken before sowing, then pressed just below the surface of the seed-bed or sufficiently deep to ensure their being kept moist and shaded. Layering is by far the quickest method of increase, for seedlings take a long time to grow.

POPLAR (*Populus alba* and *Populus nigra*, Natural Order Salicaceæ).

The many species and varieties of Poplar are readily increased from cuttings inserted in damp, open ground during autumn, or as soon as the leaves have fallen. The weeping kinds, conspicuous by their tall, erect stems and

long drooping branches, are produced by grafting on species or varieties of upright growth.

RED MAPLE (*Acer rubrum*, Natural Order Sapindaceæ).

The Red or Scarlet Maple, and many other species and varieties of these handsome, hardy, deciduous shrubs, are propagated by grafting or budding. In the case of stronger growing species and varieties, increase is usually effected by sowing seeds during autumn or spring, and by layering.

RHUS (*Rhus Coriaria* (Sumach), Natural Order Anacardiaceæ).

This ornamental tree, which is also of economic importance, together with other species and varieties, may be freely increased from cuttings of the stem, also of the root, while layering is also largely practised.

SALIX (*Salix alba* (Willow), Natural Order Salicineæ).

Willows grow freely when planted close to the water's edge, or in any moist soil, provided it is not really stagnant. Retentive, heavy soils are productive of stronger and healthier growth than those of a light and peaty character. Propagation is readily effected by cuttings of firm, ripened wood, which, when inserted in moist ground in autumn, soon produce roots and establish themselves by spring.

HARDY DECIDUOUS FLOWERING TREES

CHESTNUT (*Castanea vulgaris*, Natural Order Cupuliferæ).

CHESTNUTS may be propagated by seeds, or by grafting and budding. Well-formed and ripened seeds may be sown in autumn, or, where rats and mice prove troublesome, it is best to stratify the seeds in sandy soil and sow in spring, when it is considered that there will be no danger from frost. Drills are usually drawn two feet apart, and the seeds inserted four inches apart and from two to three inches below the surface. In the autumn of the second year the seedlings should be lifted, and their primary roots cut back to two-thirds their length, and immediately replanted at intervals of two to three feet in the rows, according to the purpose for which they are grown. The only pruning necessary is that of removing lateral branches in order to produce a clean straight stem. The choicest varieties are frequently grafted or budded on stocks of the commoner English varieties.

GUELDER ROSE (*Viburnum opulus*, Natural Order Caprifoliaceæ).

The Guelder Rose, or, as it is sometimes called, the Snowball Tree, may be readily propagated by layering or by cuttings of the half-ripened shoots during autumn or early spring.

HORSE-CHESTNUT (*Æsculus Hippocastanum*, Natural Order Sapindaceæ).

The common Horse-Chestnut is one of the most beautiful, if not the best, ornamental flowering trees in this country. Where seeds are procurable the trees may be propagated by this means, in which case they are sown in spring, ample room being allowed from seed to seed and between the rows, as they need not be removed until required for permanent planting. Chestnuts are also increased by layering in spring, while many of the other species and varieties are either budded or grafted on *Æ. Hippocastanum.*

IDESIA (*Idesia*, Natural Order Bixinaceæ).

Idesia polycarpa, and its sport, *I. p. crispa*, are handsome flowering and foliage trees, and may be propagated by inserting half-ripened cuttings in moist sandy soil, either in spring or autumn.

LABURNUM (*Laburnum vulgare* or *Cytisus Laburnum*, Natural Order Leguminosæ).

The common Laburnum, or Golden Chain, as it is frequently called, and other species, are readily increased from seeds, while the many beautiful varieties are usually raised by grafting or budding on stocks of *L. vulgare* or other commoner sorts.

LILAC (*Syringa vulgaris*, Natural Order Oleaceæ).

Lilacs are rapidly increased from suckers produced in abundance from the roots of established plants or from cuttings. The many improved varieties of lilacs, and also those for greenhouse decoration, as well as where early forcing is practised, are mostly propagated by means of shield-budding, in which case a forward pushing bud in April or a dormant bud in July should be used. Crown or cleft grafting in March is also practised on seedling stocks cut close to the ground, or those which are of sufficient length to form dwarf or tall standards. When seedling stocks are used in preference to those raised from suckers, or cuttings, there is much less likelihood of suckers being produced and so depriving the buds or grafts of nutriment which they would otherwise obtain. Vigorous growing varieties require to be grafted close to the ground, the new shoot being allowed

to run up, while those of slender growth should be united higher up in a strong growing stock.

LINDERA (*Lindera*, Natural Order Lauraceæ).

The species of *Lindera* met with in gardens are, *L. Benzoin* and *L. Melissæfolia*, both of which can be increased from cuttings inserted in sandy soil, placed under a bell glass and kept shaded and moist until rooted.

LIRIODENDRUM (*Liriodendrum tulipifera*, Natural Order Magnoliaceæ).

The Tulip Tree, of which there are many very fine specimens in England, can be propagated from seeds sown during autumn in a shady position, and where the soil consists of a moist sandy loam.

LOCUST TREE (*Robinia pseudacacia*).

The Locust Tree, or False Acacia, is readily increased by layering, whereas the rarer species and varieties are mostly grafted on the commoner sorts, as the one above mentioned.

MACLURA (*Maclura*, Natural Order Urticaceæ).

M. aurantiaca and *M. tricaspidata*, are readily propagated by cuttings when the latter are inserted in moist sandy soil on a shady border during autumn or spring.

PAVIA (*Pavia rubra*, Natural Order Sapindaceæ).

Pavia rubra (Red Buckeye) and its three varieties, together with many other species and varieties, are increased by seeds, or layers, the latter method of propagation being best performed during autumn. Grafting is also resorted to as a means of producing some of the weaker growing species and varieties.

TREE OF THE GODS (*Atlantus glandulosus*, Natural Order Xanthozylaceæ).

When grown in the open, *A. glandulosus* makes a good specimen tree, and during the first ten years or so grows very rapidly. It is easily propagated by placing pieces or slips of the root in pots containing ordinary potting compost, in such position as to retain the uppermost part of the root just above the surface of the soil. If the pots are plunged in a bed of cocoanut fibre with a gentle bottom heat, new roots are formed, and shoots will soon appear, which later on develop into strong plants.

HARDY AND HALF-HARDY DECIDUOUS SHRUBS

CLEMATIS (*Clematis purpurea*, *C. montana*, *C. Flammula*, Natural Order Ranunculaceæ).

Clematis may be propagated by seeds, cuttings, layers, and by grafting, the latter being the more usual method. If increased from seed, the pods should be gathered during autumn and carefully stored until spring, when sowings can be made in gentle heat, at a temperature of from 65° to 70° F.

When propagated from cuttings, these should consist of young wood with a heel attached, or, if not sappy, every eye will take root when inserted in pots of sandy soil and plunged in a warm bed of cocoanut fibre. Branches of plants growing in the open can be easily layered, provided that the soil covering the stem is kept moist, and roots are more readily emitted if the outside bark is rubbed off and the stem slightly twisted. Rooted layers are best severed from the parent plant and transferred to their permanent quarters in spring.

Grafting is the most usual method of increasing any particular stock, the desired varieties being grafted on the

roots of any robust growing variety, *C. Flammula* being largely in request for this purpose. The rooted cuttings are cut back close to the ground, the crown split open, and the scions inserted, after which they are carefully tied with raffia and a little of the surface soil heaped over the wound.

Clematis, if not systematically pruned, soon becomes entangled and gets out of hand, and, while many varieties are equally robust and ornamental when allowed to develop a natural habit of growth, others require keeping within bounds. Those of the *montana*, *patens*, and *florida* type should have their old wood very sparingly thinned out, as it is on this wood that the season's flowers are borne; whereas the *lanuginosa*, *Viticella*, and *Jackmanni* types bear considerably more thinning out, as they make growths on which they produce flowers annually. Pruning of outdoor varieties may be done at any time during the winter, preferably from February to April, it never being advisable to delay the work until the buds have started well into growth, although in the northern counties it is well to make sure that the more severe frosts have passed. In cutting out, the beginner must be careful not to mistake dead for live shoots, as this may easily happen; whenever possible, cut back to well-ripened wood containing strong live buds.

ELDER (*Sambucus nigra*, Natural Order Caprifoliaceæ).

The Elder is readily propagated from cuttings, which root freely when placed in any moist soil in an open situation. Little or no pruning is practised with the exception of thinning out branches which overcrowd, while if continuous pinching and cutting back is resorted to the plants can be kept dwarf.

FUCHSIA (*Fuchsia splendens*, Natural Order Onagraceæ).

Fuchsia splendens is easily propagated by cuttings, which root readily in spring when placed in any moist sandy compost. The many varieties of fuchsia are obtained by selection and careful fertilisation, the seeds from which are washed free of pulp and stored until spring, at which season they are sown in shallow pans or boxes. In raising fuchsias from cuttings, there is no better plan than that of pricking out the cuttings in shallow boxes, at from three to four inches apart each way; cuttings about three inches in length with a heel of the previous year's growth attached are to be preferred, although success can be attained wherever the young wood is sufficiently firm and matured.

GENISTA (*Genista pilosa*, Natural Order Leguminosæ).

Genistas are largely propagated by seeds and layers, or they may be reproduced by cuttings as practised in the case of many of the species of Cytisus. Cuttings of the

young wood three inches long with a heel attached, placed in a close frame under a bell glass and in a moderately warm temperature, will soon become rooted.

GLEDITSCHIA (*Gleditschia tricanthos* (Chinese Honey Locust, Three-horned Acacia), Natural Order Leguminosæ).

These ornamental deciduous trees are best propagated by seeds obtained from their natural habitats, which seeds should be sown rather deeply, say an inch or so, during the month of March.

HAMAMELIS (*Hamamelis virginiana* (Witch Hazel), Natural Order Hamameliaceæ).

This shrub produces a wealth of rich yellow flowers, which begin to expand before the leaves of the previous year's growth are shed. The seeds contain a large percentage of oil and are edible, but they are rarely utilised as a means of reproduction, as this is more readily effected by layering.

HAWTHORN (*Cratægus Oxyacantha*, Natural Order Rosaceæ).

This deciduous flowering shrub or tree is extensively utilised for hedge-making, few if any other plants possessing the same capacity of resisting or keeping at bay horned stock. When planted on loamy soil overlying clay, the common thorn or quick will continue to make

active growth for considerably over one hundred years; but if placed in shallow soils, or on impenetrable stratas of gravel, the young plants soon canker, a malady to which they will also fall a prey if unprotected after planting, and the young growths allowed to be eaten off by cattle. Hawthorns are usually propagated from seeds. The fruits or haws are gathered when ripe, and laid in shallow heaps so that the pulp may decay. They are then mixed with about one-third of their bulk of sand or finely sifted sandy soil, and a layer of four to six inches of sifted soil is spread over the heap, which is left to the following spring or autumn. Some nurserymen prefer to sow in spring in order to avoid the depredations of mice. The seeds are best sown in drills one and a half inches deep and about one foot apart, and usually at the rate of one bushel of mixed seed and sand to every one hundred yards of drill. Budding and grafting are usually resorted to in the propagation of the different or more ornamental varieties. In the pruning of hawthorn, any treatment which tends to check growth will weaken the constitution of the plant, and it is for this reason that it becomes advisable periodically to cut down old hedges that have been closely clipped for a number of years. The laying of thorn hedges, followed as the operation is by a vigorous growth of young wood, is illustrative of the plant's vitality. In forming hedges, I have found it preferable to allow the young plants to grow for one or even two seasons, after

which they should be cut close to the ground line, when a crop of strong shoots will soon appear from below the surface, and so ensure a well-filled bottom to the hedge. The foundation for a good hedge cannot be ensured unless young cleanly grown and transplanted quicks are used. In order to prevent or to lessen the disfigurement of the tops of hedges by cattle, they should be cut in such a way as to leave a flat top to the width of about one foot, and never to a point, also the hedge must not be too low.

HONEYSUCKLE (*Lonicera periclymenum*, Natural Order Caprifoliaceæ).

The Common Honeysuckle and many of the shrubby species are readily increased by cuttings or layers, and in some cases by seeds. *L. fragrantissima* and *L. Standishii* produce their flowers in the greatest profusion early in spring on ripened wood of the previous year's growth; therefore pruning must not be performed in the case of these varieties until after flowering, when all the shoots should be cut back close.

ITEA (*Itea virginica*, Natural Order Saxifragaceæ).

This ornamental shrub, which in autumn is covered with racemes of white flowers, thrives in a moist, sandy, or peaty soil; it may be propagated in spring by seeds, or by suckers, and later in the year by layering.

JESSAMINE (*Jasminum nudiflorum* and other species, Natural Order Oleaceæ).

This and other beautiful flowering species and varieties of Jessamine are propagated by inserting cuttings of firm wood in sandy peat. The more tender species require heat, while those which are hardy can be struck in open ground if kept shaded.

KADSURA (*Kadsura*, Natural Order Magnoliaceæ).

K. japonica, syn. *Sarcocarpon*, which is a half-hardy evergreen flowering shrub, is propagated from cuttings of partially ripened wood placed in sandy soil and kept in a close atmosphere and under a hand-light until rooted, due attention being given to ventilation.

KERRIA (*Kerria japonica*, *Kerria aureus vittata*, Natural Order Rosaceæ).

Kerrias are readily increased from cuttings of the young shoots if inserted under a hand-light, also by layering and division of the plants.

LEYCESTERIA (*Leycesteria formosa* (Himalayan Honeysuckle, Flowering Nutmeg), Natural Order Caprifoliaceæ).

This handsome shrub of somewhat rambling habit may be propagated from seeds sown in spring, but the more

usual method is that from cuttings of the young shoots in spring, or older ones in autumn, which cuttings must be placed under hand-lights until well rooted.

MAZEREON (*Daphne Mezereum*, Natural Order Thymelaceæ).

Daphne Mezereum, or Spurge Olive, of which there are several varieties, is now exceedingly popular. Plants are quickly raised from cuttings of matured shoots, or side growths placed in pans during autumn and kept under bell glasses will soon make roots; they must, however, be given plenty of space and attended to as regards ventilation; otherwise they will soon damp off. To lessen this danger the compost in the pots must be well drained. Many of the species used for indoor decoration are grafted on stocks of the hardier kinds owing to the slowness of growth when on their own roots.

MOCK ORANGE (*Philadelphus coronarius*, Natural Order Saxifragaceæ).

The genus comprises about twelve species of hardy ornamental shrubs, all of which grow freely in ordinary garden soil. All the species are readily propagated in spring from cuttings, suckers, or layers of matured wood; if young succulent shoots are selected, these must be placed in a cool, moist, propagating frame, and kept shaded until rooted.

In the autumn old worn-out branches should be judiciously removed to make room for new growth. The flowers, which are borne on wood of the previous year's growth, may be cut off after flowering, in order to provide new growth with as much light and air as possible, and to keep the tree within bounds.

PASSION FLOWER (*Passiflora cærulea*, Natural Order Passifloraceæ).

These beautiful half-hardy flowering shrubs are propagated from cuttings of young shoots which root freely when taken with a heel of older wood attached and inserted in a sandy compost during spring. Confinement in a propagating frame is necessary until roots are formed.

RED-FLOWERING CURRANT (*Ribes sanguineum*, Natural Order Saxifragaceæ).

This handsome flowering shrub is readily propagated by cuttings or suckers, which, if placed in moist, sweet soil in autumn as soon as the leaves have been shed, will throw out a profusion of young roots before winter sets in and the soil temperature falls.

RHAMNUS (*Rhamnus catharticus* (Buckthorn), Natural Order Rhamnaceæ).

This and many other species of Rhamnus can be readily propagated from seeds or by layering. The tender

species and varieties require a high temperature in which to grow, and are best increased from cuttings inserted in sand and kept confined in a propagating frame until rooted.

RHAPHIOLEPIS (*Rhaphiolepis indica* or *Cratægus indica*, Natural Order Rosaceæ).

This and several other species will stand English winters if given some protective covering during the very severe weather. Cuttings of ripened wood will root freely if placed in a sandy soil and kept under a hand-light until they are capable of bearing complete exposure to a cool house.

ROSE (*Rosa*, species many, and many varieties, Natural Order Rosaceæ).

The Rose is propagated by budding, grafting, cuttings, layers, and, in the case of those species growing on their own roots, by suckers or by division of the root-stock.

Standard Stocks.—The Common Briar or Dog Rose is used as a stock on which to raise standards, and in country districts can be procured during the autumn at from 1s. to 2s. per dozen, those of two-year-old growth being preferable. Planted in October or November, they will be ready for budding in the following summer. In the spring head or cut back to the requisite height and remove all side-shoots. As spring advances three or four growths

will break from the head of the stock, two or three of which must be left and the others removed. It is also a good practice to keep the base of the stock free from suckers unless such are required for removal. Many of the strong shoots, if allowed to grow, will attain a length of three feet or more, but before budding it is advisable to shorten them back to within a foot or so of the main stem, as this will check the activity of the sap in the growing point of the shoot and so better ensure the nourishing of the bud which is to be inserted near the base. Care must be exercised in the shortening back of the growth, as, should the sap be too active in the vicinity of the bud, the latter is often forced into growth immediately a union has been effected in place of remaining dormant until the following spring.

DWARF STOCKS.—Dwarf roses, or the great majority of garden varieties, are budded upon the seedling Briar, Briar cuttings, and Manetti stocks, all of which can be purchased quite cheaply from nurserymen who specialise in the raising of large numbers of stocks from seed. The Manetti stock or Italian Briar is conducive to early maturity, and hybrid perpetuals worked upon it will frequently produce big strong plants in the first year. This stock, however, should not be used for teas.

RAISING OF STOCKS.—Cuttings of the Briar for stocks are best prepared in October by selecting the tops of young shoots from eight to ten inches in length of well-

matured wood of the current year's growth from stocks which have been budded in the summer, or similar growths from hedgerow briars or dog-rose. In preparing the cutting cut just under a basal bud, removing all buds along the length of the stock and leaving only two or three near the apex. If the thorns are also removed, so much the better, but this, although facilitating the operation of budding, takes time where a large number of cuttings are to be prepared. Insert the cuttings in moist, firm, but porous soil in double rows three inches apart, or some growers prefer to tie the cuttings in bundles of fifty or so and bury them in the soil, leaving only two or three inches of their tops exposed, as all that is necessary in the first year is to ensure that the cutting will root freely. Thus, any cuttings not calloused over by spring should be thrown away, when the remainder, if planted in double rows, will root freely during summer. It is often a good plan to place rooted cuttings in the bed in which it is intended that the roses should grow, and where they can be budded. In fact, some of the best growers adopt this practice (fig. 56).

If the seed of the wild rose is sown, this must be done immediately it is ripe; if not, place in layers of moist sand in readiness for sowing in February, transplanting the seedlings in the following autumn. The cuttings of the Manetti stocks are prepared as advised for briars, but root more readily. In preparing dwarf stocks for budding it is advisable to dig a narrow trench along one side of the row

so that the collar of the stock may be exposed, after which the stems should be rubbed and cleaned with a duster or other suitable cloth.

Budding.—Budding is the method of increase usually adopted, and is satisfactorily performed during the months of July and August. Failures are often attributable to careless selection of buds, and whenever possible these must always be taken from a stock which has just flowered, rejecting the two highest buds and using only those from the centre of the shoot. If the prickles rub off easily this is often an indication that the buds are in good condition for working. In removing the wood from the bud it must be noticed whether the bud has been injured or torn out, as, if so, it cannot possibly grow. In fact, if the wood does not come away freely it is preferable not to interfere with it. After the insertion and binding of the bud (fig. 21) no further attention is needed till the spring, when, after the bud is sufficiently developed and has put forth several leaves to ensure its safety, that portion of the shoot or briar beyond the bud is cut back to within one eye of the bud, as when this eye is left to grow it draws the sap. Later, however, it is cut back as close to the bud as possible. The bud, or growth, as it now is, then receives the full benefit of the sap. It is usual to plant the stocks in rows, say two feet or so apart, and to transplant them into their permanent quarters in the autumn after budding.

GRAFTING.—Grafting is mostly practised by nurserymen desiring to increase any new variety as rapidly as possible. The plants are grafted in January, and good bottom heat is necessary. The stocks are potted in three-inch or four-inch pots twelve months or so before grafting, being placed in heat at least a fortnight before the operation. As in many other instances, the shoots of the rose to be grafted are removed and covered with moist sand so that the sap may be in a less active condition than that of the stock. The shoots or scions of the rose consist of one bud only with an adequate portion of stem attached. The stocks are cut down and an incision made so as to form a splice with the scion. The two are then bound together with raffia and covered with suitable grafting wax. The plants are then kept in a closed frame until the buds have started into growth, when air may be gradually admitted.

CUTTINGS.—Wichurianas and many of the species and climbing varieties of roses are readily propagated from cuttings of matured wood, while of garden varieties very few admit of this method of propagation. Many roses do remarkably well on their own roots, among which might be mentioned ramblers, or the multiflora hybrids, such as the Crimson Rambler, Tea Rambler, Blush Rambler, Hiawatha, and also the many varieties of Wichuriana. In fact, many of these are less rampant on their own roots than when grown on the Briar stocks. Many tea roses also do excep-

tionally well from cuttings, but it must be understood that soil and climatic conditions will have much to do with success or failure.

LAYERING.—Layering is practised where, as in many cases, difficulty is experienced in obtaining well-rooted plants from cuttings of some of the species and climbers. The majority of roses will root freely from layers, provided their shoots are sufficiently flexible to admit of bending. All that is necessary is to peg a shoot firmly in the ground, having previously partially severed it with a knife just beyond the bend where the shoot rises to the surface. To prevent the wound from closing and healing, much in the same way as a graft would unite, it is preferable to keep it open by inserting a small stone in the aperture. The species *Rosa seraphini* can be propagated in this way, as it does not readily root from cuttings; while many other varieties, the plants of which are urgently needed, can be treated by layering during spring and summer, in which case the plants will be ready for removal during late autumn.

SUCKERS.—The removal and transplanting of suckers is a method of readily increasing many types of roses such as *Rosa spinosissimi*, the Scotch roses, *altaica*, *xanthina*, and *hispida*, also *Rosa nitida*, and the many varieties of *Rosa rugosa*.

DIVISION OF ROOT STOCK.—A division of the root-stock is not to be generally recommended, although when

performed with dwarf Chinas and others of similar habit of growth success is often attained. Roses of branching habit have a tendency to produce suckers or underground stems, and when it is necessary to divide the plant it is preferable to remove it bodily from the soil during autumn and remove those portions which have a mass of roots attached. Plants which admit of this in addition to Chinas, are Polyanthi and some of the teas.

PRUNING.—Too often roses are pruned with a pair of secateurs after the manner of thinning out an old and overgrown gooseberry bush, or they are left for several years unpruned, and then severely cut or hacked about due to some sudden impulse on the part of the owner; or maybe some enthusiastic grower has impressed on him the fact that his trees are neglected and must be pruned—without giving the necessary cautions as to how best to proceed with this important work. If planted in the autumn, roses will require to be pruned towards the end of March or early in April. The former month is best for dwarf, half-standard, standard hybrid perpetuals, and hybrid tea roses; while in most seasons, dwarf and standard teas and noisettes are best left until April. The climbing varieties of the above are usually best left until March, but these also require strict attention after the flowering season is over, at which time old flowering wood must be thinned out so as to afford a better opportunity for young growth to receive nourishment, and to become

ripened while there is sufficient sun-heat to bring about this important change. In gardens where large quantities of roses are planted, I have seen planting deferred until April, in which case the plants were cut back at the time of planting, and gone over again with the pruning knife as late as the middle of May in order to remove any shoots and buds which did not look promising. This final inspection of buds is not given the attention which its practice merits, except by some of our keenest rosarians. A rose tree or bush as received from the nurseryman, or if raised in our own garden, is naturally composed of an assortment of strong and weak wood. The proportion of this wood which must be removed depends to some extent upon whether the object of the grower is to produce the best possible show blooms, or merely to grow ordinary-sized flowers. In either case, he must dispense with all weak growths by cutting them clean away, and close to where they originate from the stronger branches of the tree. On examining the remaining stronger shoots, it will be observed that the wood is firm and hard at the base, and gets softer and less matured towards the apex. This sappy unripened growth must be dispensed with if the very best blooms are to be procured; it must be cut quite close to where it springs from the still stronger stem or branch, or, if protruding from below the ground, it must then be cut close to the surface of the soil, leaving only from three to four "eyes" or dormant buds.

There are exceptions to all rules, and while this treatment is applicable to the greater number of varieties of hybrid perpetuals, hybrid teas, teas, and noisettes, there are some which must be more moderately handled by leaving the principal branches extended to a length of from eight to ten inches; and it is these moderately pruned varieties which require a certain amount of regulation towards the end of May when the buds are well formed.

PRUNING ESTABLISHED PLANTS.—While the method of pruning roses of all kinds is somewhat similar in the first year, it is not to be concluded that the same treatment will hold good at later periods in the life of the plant, and thus we find that in the second year each particular class—and in some instances distinct varieties—must be pruned in accordance with their habit of growth. One matter common to each established rose, regardless of species or varieties, is that essential operation of ridding the plant of all dead wood or young growth that may be affected with cankerous disease, also weak and unripened wood. To give a more general idea of rose-pruning is misleading to all except the expert rose-grower; and to derive practical information from an article on so important and universal a subject, it will be necessary to touch briefly on the peculiarities of these species and varieties which differ from each other in the matter of pruning.

Hybrid Perpetual Varieties.—The pruning of this class of rose—together with the hybrid teas, teas, and noisettes—has been fairly well explained in the preceding paragraphs, and it only remains to be said that the stronger growing shoots require to be less severely pruned than those possessed of weaker growths. Branches which cross one another must never be tolerated, and where pruning in every case cut to an eye pointing outwards, so as to preserve the centre of the plant open to air and sunshine. The climbing varieties of this section require very little pruning beyond thinning out the shoots where overcrowded, and removing those that are more than two years old, so as to afford space for younger growths; as these old shoots cannot serve any useful purpose after flowering, they are therefore best removed in the early summer. A common fault with many climbers is that the bottom growth is not encouraged, and consequently the lower part of walls or trellises are naked; this defect can be remedied by bending and tying down some of the strong lateral growths, or even some of the younger shoots, which are sufficiently matured to admit of bending; or if more convenient, they can be shortened back with the knife. As old plants will not admit of this treatment, all that remains is to plant a low climber at the base.

Provence and Moss Roses.—These are best pruned in March, when the old wood should be cut out; some growers prefer to leave only from six to eight of the best

growths. Strong young basal shoots should be shortened back to five or six eyes, similar treatment being given to the best laterals of the two-year-old wood. When completed, the bushes should present a nice regular appearance, the branches being well set apart, and averaging a length of twenty inches above the ground; the very strong varieties may reach to nearly thirty inches.

Penzance Sweet Briars.—These hybrids are of exquisite beauty, and quite distinct from any other class of rose; they are crosses between the common sweet briar and several other roses, such as the Austrian briar, varieties of *R. gallica*, and others. Like the common sweet briar, these hybrids are very vigorous, often throwing up shoots twelve or more feet in length. These long basal shoots may be left to whatever length is required, or when they get older can be shortened by leaving a few strong laterals to each. Lord and Lady Penzance, being of less robust growth, are best cut back to a height of about six feet. When used as hedges, these roses must be cut sufficiently short, and the laterals laid down so as to keep the lower part of the hedge filled up.

Rosa rugosa.—The rugosas are an attractive section from Japan, and are possessed of fine large flowers freely produced in terminal clusters, and succeeded by large, showy, and ornamental fruits; the foliage is of a very distinct character, persistent, and of a dark olive-green colour. The plants throw up numerous suckers from the

base, which in February may be shortened back to from three and a half to four feet, while others may be cut right out or shortened to varying lengths. Where the trees get overcrowded with growth, they are sometimes cut clean down to the ground, when in spring they break away at the base; the effect of this hard cutting back is that they bloom later in the season, but none the less freely.

CHINA AND DWARF POLYANTHA ROSES.—China roses are well suited for growing in plots or planting in beds or borders where a constant succession of flowers is desired. Pruning consists in well thinning out the growths rather than the cutting back of the individual branches, except where a few strong growths are shortened back with the object of causing them to produce new growth at the base. This is best done early in April. Polyantha or Pompon roses comprise a very interesting class equally well adapted for growing in pots. Pruning is practically identical with that advocated for the China section, and where the plants show signs of weakness the flower heads should be removed as soon after flowering as possible, as this will tend to strengthen the lateral growths.

BOURBON, AND HYBRIDS OF CHINESE AND BOURBON ROSES.—These bloom on the lateral growths of shoots two and a half years old; therefore in thinning care must be taken to leave a sufficient quantity of old wood capable of producing healthy lateral growth; avoid

hard cutting back of these and any young shoots that are to remain.

Climbing Roses.—The many varieties included in this class are among the most beautiful objects which adorn our flower gardens or pleasure grounds. The Wichuriana section, to which belongs the beautiful and popular rose, Dorothy Perkins, is the hardiest and most vigorous class of all climbing roses. This rose and others of a similar type require but little pruning, but a considerable amount of judicious thinning. As soon as the flowers are past their best they should be cut off, at the same time removing all surplus and worn-out shoots, taking special pains to see that the long sucker shoots receive every encouragement to continue their growth and ripen.

Standard Roses.—There is no more neglected bush in the average garden than the standard rose; this, however, is not always due to its not having been properly pruned, but largely because the tree is played out, and the stock is no longer capable of carrying nourishment in sufficient quantity to the mass of branches it has to support. Another reason why we see so many miserable specimens of standard roses is because many inexperienced rose-growers — and I might also include school children—indulge in the operation of budding, and often ride their hobby to death. Briar stocks are frequently planted which are old and too cankered to ever establish

themselves and produce healthy root action; also buds are inserted on these and other stocks without paying the slightest attention as to whether the variety is one that is adapted for this particular purpose, and so we have, especially in cottage gardens, numerous standard trees which are not worthy of the position they occupy. The pruning of many standard roses is wholly neglected, with the result that the head is crowded and often mis-shaped. Where varieties like W. A. Richardson, Gloire de Dijon, and Bouquet d'Or are grown on standards, they will require careful thinning; the tips of the longer shoots must be shortened back very sparingly, for, if cut in close, a mass of soft wood will be produced which will fail to produce any flowers. All superfluous and worn-out shoots are better entirely removed (fig. 57). Where hybrid perpetuals and hybrid teas are used, they should be such as develop a free, spreading habit of growth, and not those which are constitutionally weak or of an upright and compact habit. Apart from this, pruning is identical with that advocated for the same varieties of roses when growing as dwarfs, except that in the former case fewer shoots are developed from the base or union with the stock; therefore the principal growths of the preceding year must be made the most of by cutting back to strong buds or "eyes" near to the base.

SHEPHERDIA (*Shepherdia argentea* (Beef Suet Tree), Natural Order Elæagnaceæ).

S. argentea and *S. canadensis* may be propagated in many different ways, either from seeds, root cuttings, layers, or suckers.

SPIRÆA (*Spiræa confusa* (syn. Media), Natural Order Rosaceæ).

The great majority of Spiræas and especially the herbaceous perennials are readily increased by division of the root stalks. Shrubby spiræas are mostly propagated by cuttings of the young wood, which must be kept close and shaded until rooted. Some species are easily increased by root offsets, which are freely produced throughout the summer and can be removed for transplanting in autumn.

SYMPHORICARPUS (*Symphoricarpus racemosus*, Natural Order Caprifoliaceæ).

S. racemosus, or Common Snow-Berry, is freely increased from suckers which are abundantly produced.

VIRGINIAN CREEPER (*Ampelopsis hederacea*, Natural Order Ampelideæ).

This popular and ornamental leafy climbing shrub and other species and varieties are readily propagated from cuttings taken in September, which must have a good eye attached. They may be pricked out on an open border under hand-lights, or into a cool frame containing several inches of sandy soil, in which they will soon root, and be fit for transplanting early in spring. Propagation can also be effected by taking soft-wooded cuttings in spring from plants specially grown for that purpose, in which case the cuttings must be subjected to gentle heat; this treatment applies particularly to *A. tricuspidata.* Layering is also practicable, while some of the finer-leaved and more delicate varieties are increased by grafting on the roots of the stronger species, in which case stocks are provided from cuttings inserted in frames during autumn, and cut back to the ground level in spring in readiness for grafting.

WISTARIA (*Wistaria chinensis*, Natural Order Leguminosæ).

The Wistaria is readily increased by layering the young growing shoots during summer, when in the autumn of the following year they can be completely severed and transplanted, by which time a good mass of roots will have formed.

ZANTHOXYLUM (*Zanthoxylum fraxinifolium* (Prickly Ash), Natural Order Rutaceæ).

Ripened cuttings of this shrub are usually used for purposes of propagation, shoots from well-seasoned wood being placed in sand, covered with bell glasses, and kept fairly cool. Stove species may be similarly treated, except that they demand more heat.

The close pruning or cutting hard back of many flowering shrubs, although producing the desired results from the cultivator's point of view, especially with regard to the production of bloom, often seriously affects the life of the plant. Among such shrubs may be mentioned Forsythias, *Philadelphus Lemoinei erectus*, *Prunus triloba flore-pleno*, and *Prunus sinensis flore-pleno*. Others which flower late in the spring, as *Spiræa japonica* and allied species, Tamarix *Hispida æstivalis* (*Pallasii rosea*), *Hydrangea paniculata* and var. *grandiflora*, Coluteas, Hypericums, Indigoferas, and the varieties of *Buddleia variabilis*, benefit most when hard pruned in March, while Deutzias, Berberises, Kerrias, and Philadelphuses should have the old growths cut out close to the base.

The character of growth will usually indicate when and how pruning can best be performed.

HARDY EVERGREEN AND CONIFEROUS TREES

ILEX (*Ilex aquifolium* (Holly), Natural Order Ilicinaceæ).

I. aquifolium, the Common Holly, and other species are largely propagated from seeds, as in the manner practised with the hawthorn, being collected when ripe and buried in sand until the following spring. The many beautiful variegated and other highly ornamental varieties are propagated by grafting in spring, preferably in March, or by budding in May with a pushing bud on stocks of the common kinds, or by budding in August, when a dormant bud must be used. Apart from their use as specimen trees, the common hollies are largely utilised in the formation of hedges. The successful growth of either individual trees or hedges is largely dependent upon careful planting, and at the proper season, which is either at the beginning of May or in early autumn, in order that young roots are given an opportunity to form. If planted in mid-winter, and where the ground is naturally cold and wet, many of the plants perish, or where they do not survive, a severe check is given and young growth is retarded.

LARCH (*Larix Europæa*, Natural Order Coniferæ).

The Larch, like the great majority of coniferous trees, is propagated by seeds. To extract the seeds from the cones the latter are heated on a timber kiln to a temperature of about 105° F. in order to make them brittle and dry, after which the seeds are flailed out.

If stout, firm transplants are carefully tended in the nursery rows, and the primary root kept intact, they may be put out in the open when two years old, and when established will make rapid growth. Owing to their insensitiveness to late frosts, they are frequently utilised as nurses for less hardy species of trees in localities exposed to late frosts in spring. The Larch has a deep-reaching root system like that of the Scots Pine, and a good depth of soil is therefore essential for its welfare.

LIBOCEDRUS (*Libocedrus*, Natural Order Coniferæ).

L. chilensis, and other species, are very similar in habit of growth to *Thuya*, under which the present genus was originally classed. Propagation is readily effected by sowing seeds in frames, the seedlings being gradually hardened off and later planted in the open ground. Cuttings of half-ripened shoots will root if placed in a cool shaded frame during August.

MONKEY PUZZLE (*Araucaria imbricata*, Natural Order Coniferæ).

A. imbricata and other species of this Araucaria are mostly propagated from seeds sown in pans or boxes, which are best plunged in a moist warm bed of cocoanut fibre, as the seeds take a long time to germinate if a constant state of moisture and warmth is not kept up. Cuttings consist of the leading shoots, to ensure the rooting of which it is essential that they be firmly fixed in pots of cool sand, and kept at a moderate temperature until a callus is formed, after which, if gentle heat is applied, root action is stimulated. Young growth developed from the rooted cuttings may be similarly treated.

SCIADOPITYS (*Sciadopitys*, Umbrella Pine, Natural Order Coniferæ).

S. verticillata rarely ever ripens its seeds in this country, and when it is necessary to raise new plants, imported seeds are sown, this being found the most effective and ready means of propagation.

JUNIPERUS (*Juniperus communis*, Natural Order Coniferæ).

The various members of this genus are raised from seeds which retain their vitality in the berry for several

years. The seeds germinate irregularly, some showing above ground at the end of the first year, and others at the end of the second year. Cuttings also provide another means of increase, and these should be made from young ripened growths during autumn, and kept in a close frame, or under hand-lights during winter. Layering is also practicable.

LEBANON CEDAR (*Cedrus Libani*, Natural Order Coniferæ).

The Cedar of Lebanon, as well as several other species, is propagated from seeds gathered during the spring, and sown in pans, which are kept in a cool frame until germination has taken place, after which they are placed in the open to harden, and planted out in nursery rows in the following spring. The cedar does not withstand pruning of root or branch, while if the leader is removed the tree assumes a picturesque form—the more so as the branches age.

NOBLE SILVER FIR (*Picea nobilis*, Natural Order Coniferæ).

Abies nobilis and the various species and varieties of pines are propagated from seeds sown during spring in pots containing sandy loam, or in carefully prepared seed-beds in the nursery. The soil of the seed-bed must be

made firm by consolidating with a roller before, and if necessary after, sowing. The seeds should be covered very lightly with soil, and in no case must they be inserted deeper than a quarter of an inch. Keep the beds watered and shaded until the seedlings have become hardened. In the following season seedlings hardened off in the pots, or those in the seed-bed, can be transplanted into nursery rows, or planted in their permanent quarters. Variegated and delicately constituted species and varieties are usually grafted on those of more robust habit of growth.

NORWAY SPRUCE (*Abies excelsa*, Natural Order Coniferæ).

A. excelsa, synonym of *Picea excelsa*, requires treatment similar to that advocated for other species of *Abies*.

PINE (*Pinus austriaca, Pinus excelsa*, etc., Natural Order Coniferæ).

These and other species require the treatment as advised for *Abies* and other Coniferæ of similar constitution and habit of growth. It is often practicable to sow the seeds of many pines in the position they are intended to occupy permanently, in which case the necessary preparation of the ground and attention to the seedlings must be given until the plants are well established.

SEQUOIA (*Sequoia gigantea, Wellingtonia gigantea,* or Mammoth Tree, Natural Order Coniferæ).

This handsome species and others of the same genus are mostly propagated by means of seeds and cuttings. When the former are obtainable they should be sown in cold frames, the seedlings being transplanted in open ground when large enough to handle. Cuttings are inserted in sandy soil during autumn and placed under hand-lights in a moist atmosphere, and kept shaded until well rooted. As with other Coniferæ, the variegated forms are most effectively propagated by grafting.

TAXUS (*Taxus baccata* (Yew), Natural Order Coniferæ).

The Common Yew is readily propagated from seeds, cuttings, and also by means of layering. The ripe fruits are mixed with sand, and treated in the same way as advised for hawthorn until the spring, when they are sown in beds, and later transplanted into nursery rows. Cuttings are inserted in frames containing sandy soil during August, or under hand-lights, and kept well shaded until rooted. Layering is also practicable. The variegated golden varieties and those of pendulous growth are usually grafted on tall stems of the common upright type.

THUYA or THUJA (*Thuja occidentalis*, *Arbor Vitæ*, Natural Order Coniferæ).

The American *Arbor Vitæ*, apart from their beauty as specimen trees, are valuable as hedge plants, where a screen or shelter hedge of quick-growing Coniferæ are required. All the species are readily raised from seeds or cuttings. Seeds are sown in spring under glass in pots of sandy loam, and when hardened off, are then pricked out on open ground. Cuttings of half-ripened shoots are easily rooted if placed in gentle heat under bell glasses, or inserted in a cool frame during August, and kept shaded. Variegated forms are grafted on seedling stocks of the commoner types.

THUYOPSIS (*Thuyopsis gigantea*, Natural Order Coniferæ).

In the genera *Plantarum* the species of *Thuyopsis* are included under *Thuya*. The hardy evergreen Coniferæ are propagated in exactly the same manner as advocated for *Thuya*.

TREE OF THE SUN (*Retinospora obtusa*, Natural Order Coniferæ).

R. obtusa is a synonym of *Chamæcyparis obtusa*, a genus which ranks very closely to *Cupressus*. The varie-

gated species are freely increased by seeds and by cuttings, the latter being the more general method of propagation. Cuttings of side shoots with a heel attached should be selected in autumn and inserted in well-drained pots of sandy soil, and placed in a close cool frame, and kept moist throughout the winter. When the cuttings have calloused they should be placed in gentle heat to encourage root action.

UPRIGHT CYPRESS (*Cupressus sempervirens stricta*, Natural Order Coniferæ).

Cupressus may be propagated from seeds or cuttings. Seeds are collected during spring, or as soon as the cones burst open, and they are sown during April in carefully prepared beds, which if kept moist will stimulate the seeds into rapid germination. At the end of the first year's growth the seedlings should be transferred to nursery rows, and again subjected to transplantation every second year, in order to encourage the formation of fibrous roots.

HARDY EVERGREEN SHRUBS

AUCUBA (*Aucuba japonica* (Variegated Laurel), Natural Order Cornaceæ).

AUCUBAS may be propagated readily by inserting cuttings in a compost of loam, sand, and leaf-mould, either in spring or autumn. Seeds sown immediately they are ripe are also a common means of increase where a large stock is desirable. The plants grow freely in any ordinary cultivated garden soil, and require no special manipulation as regards pruning. To ensure a goodly supply of berries on the female plant, the flowers must be fertilised with pollen from the male plant. Should the male flowers be developed in advance of the female flowers the pollen may be collected into a small glass tube or bottle, using a dry camel's-hair brush for the purpose; in this way it may be preserved for several weeks without losing vitality.

BOX TREE (*Buxus sempervirens*, Natural Order Euphorbiaceæ).

The Box may be propagated by seeds, layers, or from cuttings of the young wood. Cuttings should be inserted

in a shady situation during the months of August and September, when, if the soil be moist and well drained, they will root freely; the length of the cuttings need not exceed six inches. The cuttings of the Balearic Box (*B. balearica*), and the Japanese varieties *B. japonica* and *B. microphylla*, require shelter until the plants are well established. No special preparation of the soil is required when planting Box, other than trenching the ground to be occupied. Owing to the fibrous nature of the roots, large specimen trees may be transplanted with comparative safety. No pruning is required in order that the tree should assume a more natural habit of growth, but rather otherwise, as it lends itself to topiary gardening on account of its suitability for clipping into regular forms. *B. suffruticosa* is the species used for edging purposes.

EUONYMUS (*Euonymus Europæus*, Natural Order Celastrineæ).

The Euonymus is very easily propagated from cuttings of the previous season's growth. These should be about three inches in length, and they will be found to root quickly when placed in a mixture of sand and loam during early autumn.

LIQUSTRUM (*Liqustrum vulgare* (Privet), Natural Order Oleaceæ).

The Privet is largely in request for garden hedge-making, where quick growth is necessary or desirable. Pro-

pagation is readily effected from cuttings of young matured shoots. In nurseries seeds are sometimes sown after the manner advised for hawthorn. Privet is in no way affected by cutting or pruning, and in order to make a firm thick hedge the plants must be kept cut back.

MYRICA (*Myrica acris*, Natural Order Myricaceæ).

Myrica acris is probably better known as *Pimenta acris*, commonly termed the Black Cinnamon or Wild Clove. It is propagated by cuttings of the young shoots, which must be firm at the base; otherwise success will not be attained. The cuttings root best in pans of moist sand under a bell glass, and they should be subjected to a gentle bottom heat.

PHILLYREA (*Phillyrea angustifolia*, Natural Order Oleaceæ).

Phillyrea are easily raised from cuttings, or they may be grafted on the Privet.

RUSCUS (*Ruscus aculeatus* (Butcher's Broom), Natural Order Liliaceæ).

Butcher's Broom is a native of the British Isles. This interesting plant which is found growing wild in so many parts of England can be utilised with good effect in gardens, and it is readily propagated by means of root suckers.

SOUTHERNWOOD (*Artemisia absynthium* (Wormwood, Old Man), Natural Order Compositæ).

This shrub is well known for its fragrance, and for generations past has held a prominent position in cottage gardens. It is easily propagated by cuttings, which root freely in early summer when placed in a moist shady position. Plants may also be raised from seeds.

YUCCA (*Yucca acuminata*, Natural Order Liliaceæ).

Yuccas are extremely ornamental plants, capable of producing very striking effects when skilfully utilised in garden ornamentation. They may be propagated either by division or by severing pieces of the thick fleshy roots into short lengths, and inserting them in soil or cocoanut fibre to which bottom heat is applied. Seeds are rarely ever produced in this country.

HARDY EVERGREEN FLOWERING TREES AND SHRUBS

FURZE or GORSE (*Ulex europæus*, Natural Order Leguminosæ).

THIS hardy evergreen shrub is very picturesque when in flower, and in many parts of Scotland it is used for hedge-making, its spiny growth proving objectionable to cattle which try to force their way through it. New plants are readily raised from seeds or cuttings.

GARRYA (*Garrya elliptica*, Natural Order Cornaceæ).

This ornamental shrub with its pendulous catkins is raised from seeds or by cuttings from partially ripened wood in August, which must be kept moist and shaded until rooted.

GAULTHERIA (*Gaultheria procumbens* (Winter Green), Natural Order Ericaceæ).

This species produces red berries which are edible. Propagation is readily effected by divisions or by layering.

HEATHS (*Erica cinerea*, Natural Order Ericaceæ).

Ericas are usually increased by cuttings an inch or so in length, taken from the points of the twiggy ripened shoots situated on or near to the lower parts of the plants. They require to be very carefully handled, and must be inserted in well-drained pans, filled with fine sandy peat, covered with a layer of silver sand. After the insertion of the cuttings, give a good watering, place in a close frame at a temperature of 60°, and cover each pot with a bell glass, which must be frequently wiped inside with a chamois leather, or damping will soon make its appearance. When the tips of the cuttings show signs of growth, air must be gradually admitted and the young plants afforded more sunlight. At a later stage the growing points must be stopped, to induce lateral branching. The plants are allowed to remain in the pans until the following spring, when they are potted in small pots and grown on. Pruning is best effected immediately the flowering season is over. Free-growing varieties, and those of a softer wooded habit, must have their strongest shoots shortened back to within an inch or so of their bases, while all the weaker shoots must have their tips removed; some of the lower growth may not require pruning, while, where the symmetry of the plants has to be regarded, the pruner should use his own discretion. The secret of the successful cultivation of Heaths lies in proper watering

and ventilating, over-watering being even more fatal than under-watering; but these are matters which must be learned by experience.

IVY (*Hedera helix*, Natural Order Araliaceæ).

The common species of Ivy are readily increased from cuttings of young firm wood, while the many beautifully leaved and coloured sports are grafted on the more robust kinds. In procuring stocks for grafting, short portions of the stem are placed in pots and kept in a cool frame until well rooted, when in early spring they are cut back to the level of the soil, the scions inserted and tied up with raffia, soil being placed over the joint. This method enables one to produce plants more rapidly than from cuttings.

KALMIA (*Kalmia latifolia*, and other species, Natural Order Ericaceæ).

These handsome flowering shrubs may be propagated by seeds sown in shallow pans, well drained, and filled with fine sandy peat. After wintering, they should be kept in a cool frame until the seedlings are large enough to handle. The more usual method of propagation, however, is by means of cuttings of young growths treated in a manner similar to that advised for heaths, and kept shaded until well rooted.

LAUREL (*Laurel nobilis* (Bay Laurel), Natural Order Lauraceæ).

L. nobilis, or Sweet Bay Tree, is readily propagated from cuttings, which should be inserted in sandy soil and kept covered with a bell glass, and carefully attended to as regards moisture, ventilation, and shading until rooted. Seeds may also be sown where procurable, which is the case where plants of the two sexes grow together. The common laurel (*P. Laurocerasus*), with its numerous varieties, and the Portugal laurel (*P. lusitanica*), together with the various species and varieties, are propagated by seeds, cuttings, grafting, or budding. Seeds may either be sown in autumn or stored for spring sowing. Cuttings are best inserted during autumn, and must be kept shaded, or placed in a naturally shaded position.

LAURUSTINUS (*Viburnum Tinus*, Natural Order Caprifoliaceæ).

This and other species of *Viburnum* are readily increased from cuttings of the half-ripened shoots inserted in sandy soil in cool and shaded frames during spring, or in warm shady borders in autumn. Propagation may also be effected by layering.

LEUCOTHOË (*Leucothoë*, Natural Order Ericaceæ).

This genus contains some eight species of handsome hardy flowering shrubs, which may be propagated by seeds, layers, or divisions of established plants. Seeds should be sown in pans of peaty soil and covered very lightly, but as growth is so very slow in the early stages of the plant, layering or division is more usually resorted to.

MAGNOLIA (*Magnolia acuminata*, Natural Order Magnoliaceæ).

These handsome flowering trees are propagated in a variety of ways. Well-ripened seeds may be sown in frames, while many species and varieties are increased by veneering and side cleft grafting in July or August, the stocks being kept in a close moist atmosphere until a union is effected. Layering is also a successful and quick means of multiplication.

RHODODENDRON (*Rhododendron ferrugineum*, Natural Order Ericaceæ).

These highly ornamental flowering shrubs, of which there are numerous species, hybrids, and varieties, may be propagated in very many different ways—namely, by seeds, cuttings, layers, grafting, and budding, while inarching is also practicable. Seeds of the rhododendron are very small; therefore they require careful sowing.

February or March are the best seasons during which to sow, and in order to ensure successful germination, pans well drained and filled with sifted peat and sand must be prepared. Water the soil in the pans and allow the latter to drain before sowing. After the seeds have been thinly scattered over the surface, place the pans in a cool shaded frame, or in a very gentle heat, according to the requirements of the species that are being sown. Finely chopped sphagnum moss is sometimes sprinkled over the surface of the soil as a means of retaining moisture around the seed, but this must be carefully removed immediately germination takes place. When the seedlings are large enough to handle, they must be pricked off into pans containing similar compost to that in which the seeds were originally sown, and these seedlings should then be shaded until well established, afterwards being gradually hardened off. When propagation by means of cuttings is tried, always select partially ripened wood, and insert the cuttings in peaty soil, allowing a little sand to adhere around the base of the cuttings. Then place them in a cool frame and keep shaded. When they have developed a healthy callus, the bottom temperature should be slightly raised so as to induce root formation. Established varieties of rhododendron are usually reproduced by grafting on stocks raised from seeds or cuttings of the medium or stronger growing species or varieties, and this is successfully performed during late summer when the

wood of the scion is ripe; while in the case of greenhouse varieties the operation of grafting is best performed in winter. Newly grafted plants must always be kept in a close atmosphere until a union of stock and scion is effected. Inarching is practised in such species and varieties as prove difficult to increase by budding or grafting.

STRAWBERRY TREE (*Arbutus uredo*, Natural Order Ericaceæ).

The propagation of this exquisite shrub is most effectively secured by sowing the seeds in sand, or very sandy soil, during early spring. Budding, grafting, and inarching are also practised in the case of many of the other species and varieties, *A. uredo* being used as a stock.

TAMARIX (*Tamarix gallica*, Natural Order Tamaricaceæ).

This ornamental shrub and other species of the order are readily increased by cuttings, which should be inserted in sand and kept under a bell glass until rooted. The greenhouse kinds require a slightly heated atmosphere, accompanied by gentle bottom heat, care being taken to keep the glasses free from condensed moisture and to admit ventilation when required.

STOVE AND GREENHOUSE FOLIAGE AND FLOWERING TREES AND SHRUBS

Stove Evergreen Flowering Tree

JACARANDA (*Jacaranda folia* (Ebony Tree), Natural Order Bignoniaceæ).

THE majority of species comprising this genus may be propagated from cuttings of half-ripened shoots, which, if placed in heat during early summer and kept shaded, will soon become rooted.

Stove Evergreen Flowering Shrub

GARDENIA (*Gardenia florida*, Natural Order Rubiaceæ).

The double forms of *G. florida* and *G. radicans* produce beautiful and highly perfumed flowers, which are in great demand by florists. These, and other species and varieties of Gardenia, are propagated by cuttings, which should be selected from among those of strongest growth, for preference during the month of January, as this affords

the young plants a long season of growth before flowering. The best rooting medium is sandy peat, but if the cuttings are taken with a heel of older wood attached and plunged in bottom heat of a temperature of 70° to 75° F., and kept close, they rarely fail to root.

IXORA (*Ixora coccinea* (West Indian Jasmine), Natural Order Rubiaceæ).

This and many other species of Ixoras are readily increased by cuttings. Sturdy and short-joined cuttings, the wood of which is firm and matured, succeed best, and these should be inserted singly in small pots containing finely sifted peat and sand, and afterwards plunged into a bed of cocoanut fibre at a temperature of from 75° to 80° F., and kept covered with a hand-light admitting air sparingly until rooted.

STEPHANOTIS (*Stephanotis floribundis*, Natural Order Asclepiadaceæ).

This delicately scented plant of trailing habit of growth and white jasmine-like flowers can be increased by cuttings of the previous year's growth. The cuttings are best taken in spring, and inserted singly in small pots and kept in a close frame at a temperature of 60° F.

Greenhouse Evergreen Flowering Shrub

HOVEA (*Hovea*, Natural Order Leguminosæ).

H. elliptica and other species of these handsome ornamental greenhouse evergreen shrubs are freely propagated from seeds sown in spring in well-drained pots containing sandy peat and placed on a hot-bed. When large enough to handle, prick the seedlings off singly into small pots, and grow on in gentle heat, keeping the points pinched out in order to promote a bushy, compact growth. Cuttings of hoveas do not strike readily; therefore this method of increase is rarely tried.

ILLICIUM (*Illicium anisatum* (Star Arise Tree), Natural Order Magnoliaceæ).

I. anisatum and other species are propagated from cuttings of young ripened shoots, and in order to facilitate rooting these should be placed under bell glasses during the summer.

LEONOTIS (*Leonotis*, Natural Order Labiatæ).

L. Leonurus, Lion's Tail and other species of these ornamental greenhouse plants, may be propagated by cuttings, which root freely during early spring if inserted in pots containing sandy loam and subjected to gentle bottom heat.

MONOCHÆTUM (*Monochætum*, Natural Order Melastomaceæ).

All the species of this genus are easily propagated from cuttings placed in sandy peat and covered by a hand-light in a warm temperature until rooted.

OLEANDER (*Nerium Oleander*, Natural Order Apocynaceæ).

The Common Oleander, like other species, although ornamental both in foliage and flower, is extremely poisonous. Propagation is effected by inserting cuttings singly in thumb-pots, and placing these in a close, warm frame, or they may be rooted in bottles of water, into which a few lumps of charcoal have been placed. When rooted, they should be carefully potted and kept warm until established.

Greenhouse Evergreen Shrub

INDIA-RUBBER TREE (*Ficus elastica*, Natural Order Urticaceæ).

Ficus elastica is very largely cultivated as a foliage plant for sub-tropical bedding as well as for decoration. Nurserymen reproduce this species from cuttings or eyes with a leaf attached. These are placed singly in pots, a small stake being pierced through the leaf, and fixed in the

soil so as to keep the cutting in position. The cuttings must be kept in a close warm frame, and the pots plunged in cocoanut fibre so as to encourage the promotion of roots.

MYRTLE (*Myrtus communis lusitanica*, Natural Order Myrtaceæ).

Myrtles are readily increased from cuttings of firm and partially ripened wood inserted in a close frame. Species requiring a stove temperature need more bottom heat, and a house with a correspondingly high temperature.

Greenhouse Evergreen Foliage Shrub

GREVILLEA (*Grevillea robusta*, Natural Order Proteaceæ).

G. robusta and the majority of other species of this genus are increased from seeds, while others admit of layering. Some of the rarer kinds are grafted on stocks of those species or varieties of stronger constitution.

Greenhouse Flowering Shrub

HELIOTROPIUM (*Heliotropium peruvianum*, Natural Order Boraginaceæ).

H. peruvianum, the Common Heliotrope or Cherry Pie, is one of the most popular greenhouse flowering shrubs, and is also largely used for the purposes of bedding, its dark green foliage and blue flowers of unsurpassed fragrance

being much admired. This and other species and varieties are readily propagated in spring from cuttings of the young growing points taken from plants which have been carefully housed throughout the winter. Gentle bottom heat will encourage root action, while if the extremities of the shoots are pinched, lateral branching will be encouraged. Propagation may also be effected from seeds.

LABICHEA (*Labichea*, Natural Order Leguminosæ).

L. lanceolata may be propagated from cuttings of half-ripened shoots which, if placed in sand and kept under a bell glass, will root during summer.

LEDUM (*Ledum palustre*, Natural Order Ericaceæ).

Ledums are usually propagated by layering in peaty soil, or by dividing the plants in autumn or winter, in which operation care must be taken to keep the soil around the roots intact. Propagation is rarely ever effected by seeds, as the plants take some considerable time to become established.

Greenhouse Evergreen Flowering Climbing Shrub

METROSIDEROS (*Metrosideros scandens*, Natural Order Myrtaceæ).

This and other species may be increased from cuttings in spring, and they require a little bottom heat to promote root action.

Palms

KENTIA (*Kentia Belmorsana*, Natural Order Palmaceæ; also *Kentiopsis*, Natural Order Palmaceæ).

These, and in fact the great majority of palms, are propagated from imported seeds, which are usually sown in pans or boxes, or, where propagated in large quantity, they are pricked in beds or frames in whatever temperature is best suited to them, the tropical varieties requiring a temperature of anything up to 80° F. As soon as germination has taken place the seedlings are potted separately into small pots of more than ordinary length, as the primary roots of many of this species are very long, and care must be taken not to damage them by cramping or breaking.

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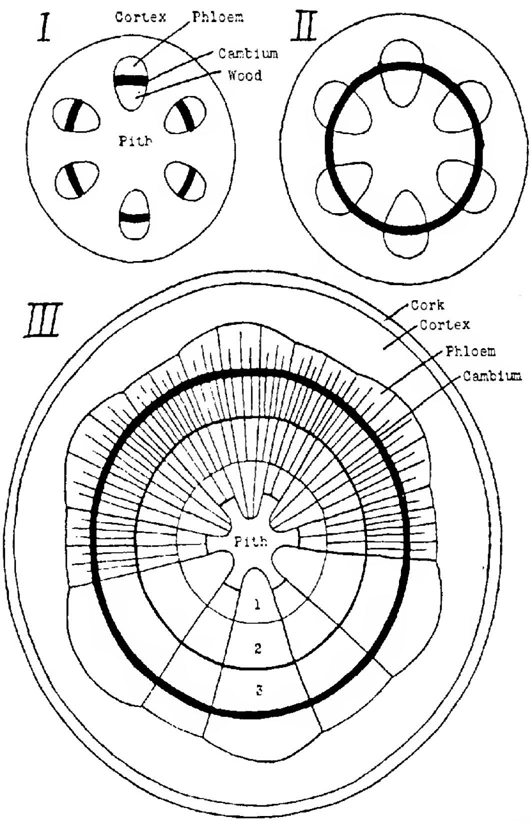


FIG. 1.—Diagrammatic cross-sections of a dicotyledonous stem at different stages. In I. the bundles of the young stem are distinct from each other, being separated by the broad primary medullary rays, which consist of ground tissue continuous with the similar tissue in the pith and in the cortex. In II. the cambium has become a complete ring by the formation of strips of cambium (inter-fascicular cambium) in the rays, these strips being joined up to the cambium (fascicular cambium) in the bundles themselves. In III. the completed cambium ring has given rise to secondary wood internally (showing three annual rings of growth) and to secondary phloem externally; the radial lines in the wood and phloem represent the medullary rays, and a layer of cork has been formed on the outside of the stem.

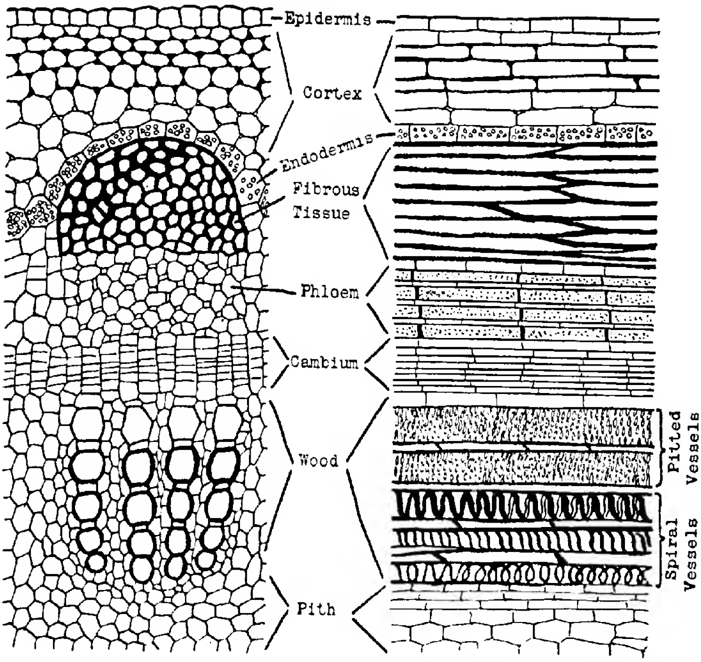


FIG. 2.—Partly diagrammatic transverse (upper) and longitudinal (lower) sections through a young dicotyledonous stem, showing the various tissues.

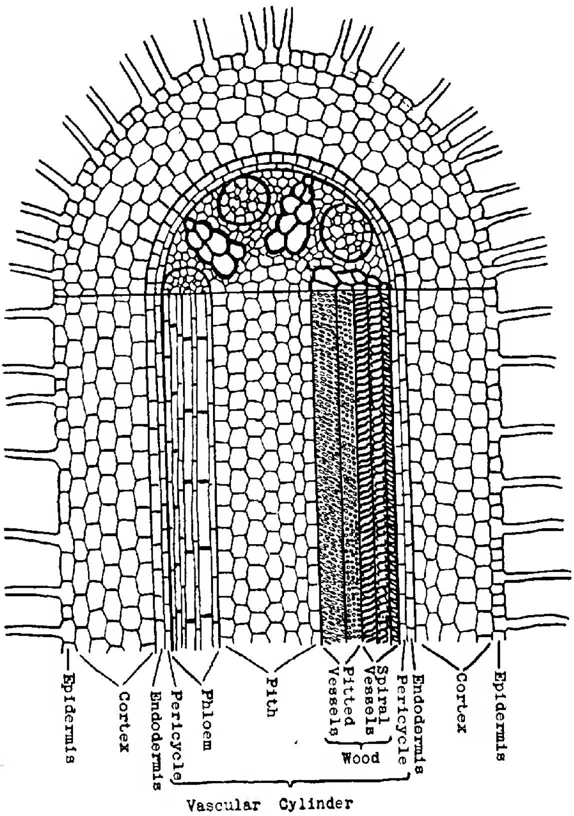


FIG. 3.—Partly diagrammatic representation of the primary structure of a dicotyledonous root, shown in transverse section above and in longitudinal section below; one-half of the transverse section is shown—the root has five wood bundles and five phloem bundles in all. The numerous root-hairs arising from the epidermis (also called "piliferous layer") are cut short; these hairs are in reality long filaments, their length being several times the diameter of the young root.

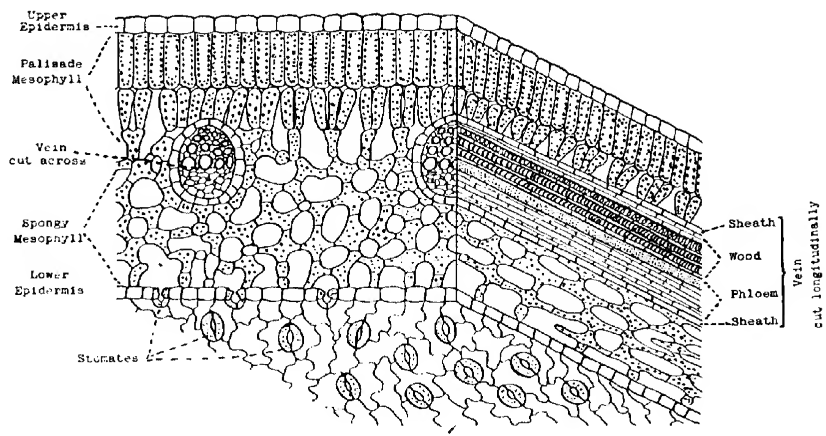
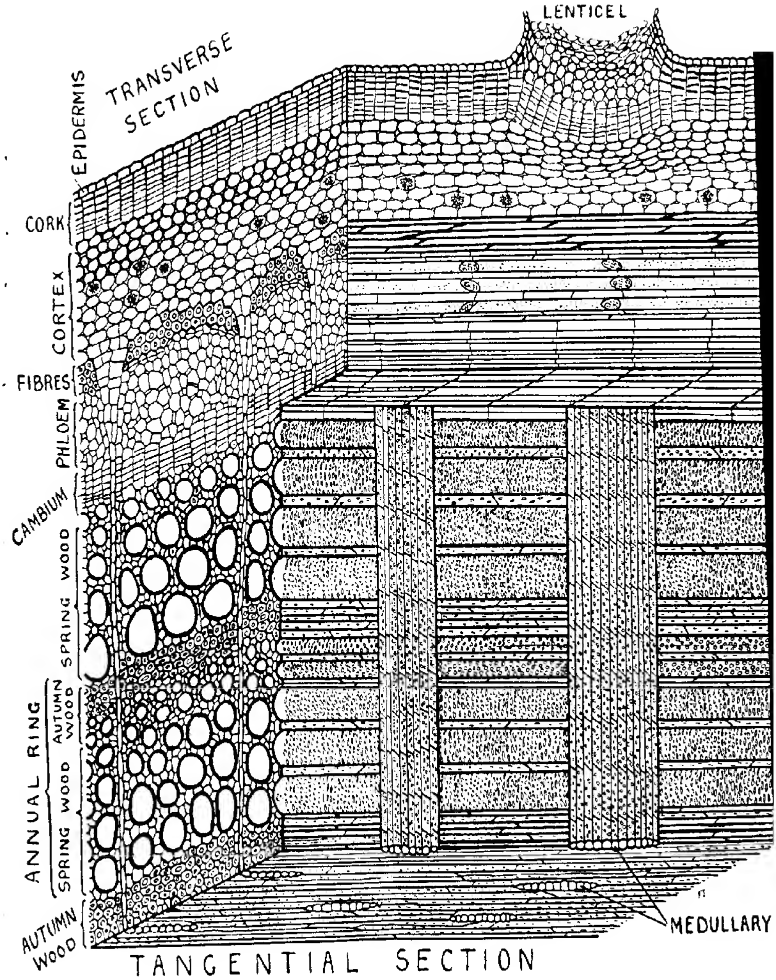


FIG. 4.—Partly diagrammatic representation of the structure of a foliage leaf, showing transverse section, longitudinal section, and lower surface. See description in text.


LENTICEL
TRANSVERSE SECTION
EPIDERMIS
CORK
CORTEX
FIBRES
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MEDULLARY
TANGENTIAL SECTION

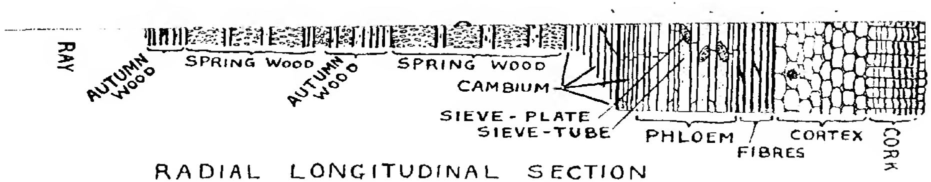

FIG. 5.—Outer portion of a woody dicotyledonous stem, showing the structure of the tissues in a partly diagrammatic manner. The upper portion of the diagram shows the tissues in transverse section; on the left the wood is shown in tangential longitudinal section; in the middle the wood is shown in radial longitudinal section, then (towards the right) the cambium is cut tangentially, and finally the outer tissues (from cambium to epidermis) are again cut radially. The transverse section shows two medullary rays traversing the phloem, cambium, and wood; two annual rings of wood are shown; two medullary rays are seen traversing the wood in the radial section, and several rays are cut across in the tangential section on the left; some cluster-crystals of oxalate of lime are shown in the cortex cells; a lenticel is shown on the right of the diagram.

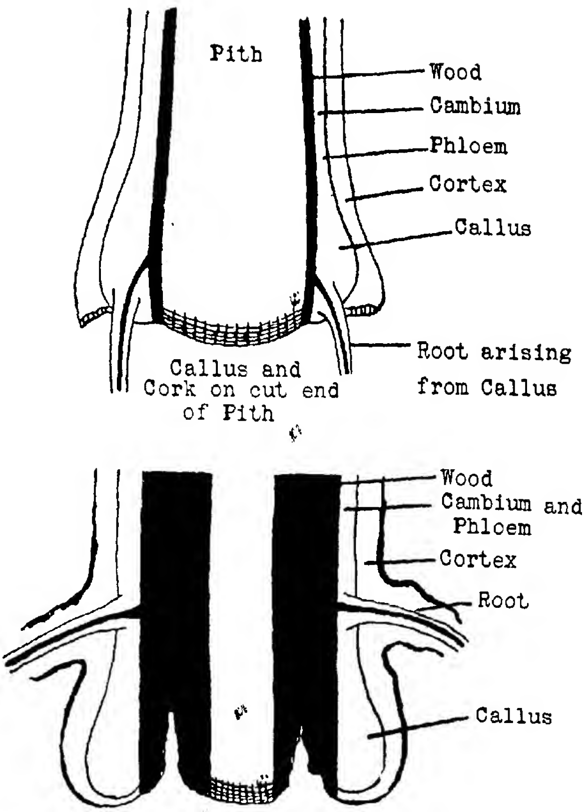

FIG. 6.—Diagrammatic longitudinal sections through the base of a herbaceous (upper) and of a woody (lower) cutting.

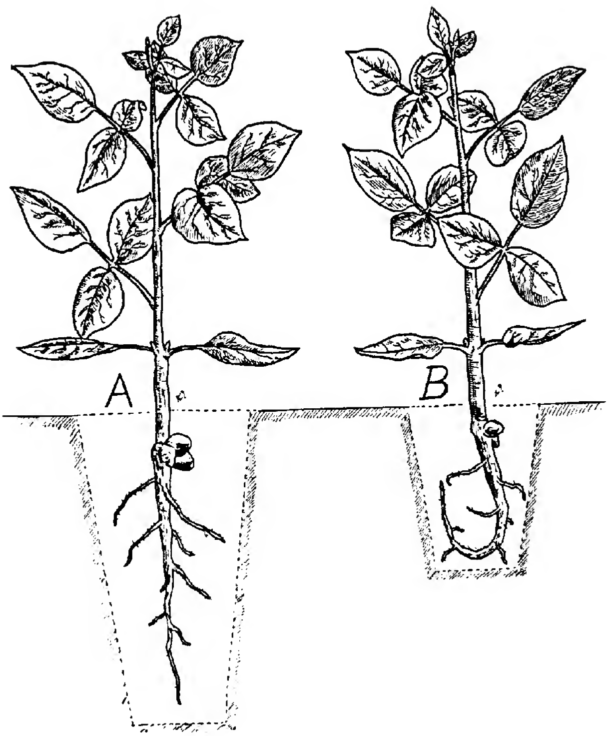

Fig. 7.

A, Proper method of transplanting seedling; the roots being given ample freedom.
B, Wrong method; the roots cramped and turned upwards.

"Eye" or dormant bud of vine, obtained by cutting ½ inch above and below the bud.

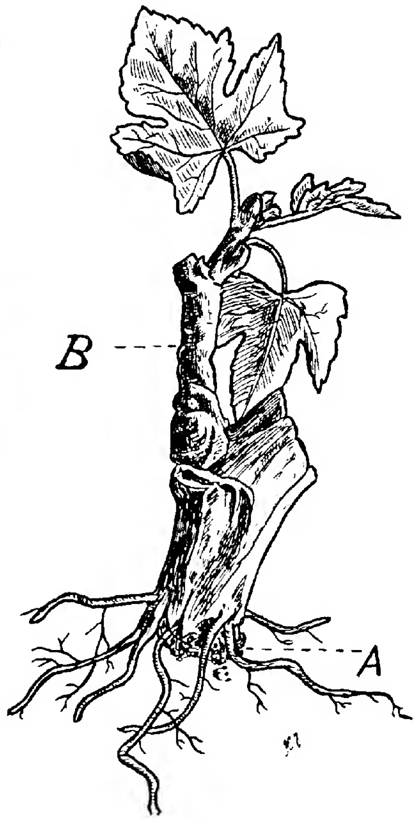

Fig. 8.—Germinating vine bud. At this stage the young plant requires every care, as a careless and irregular supply of heat or moisture will be attended with fatal results. A temperature of 80° F. is desirable.

A, Callus and base of stem from which roots are emitted.
B, Growth of bud with leaves attached.

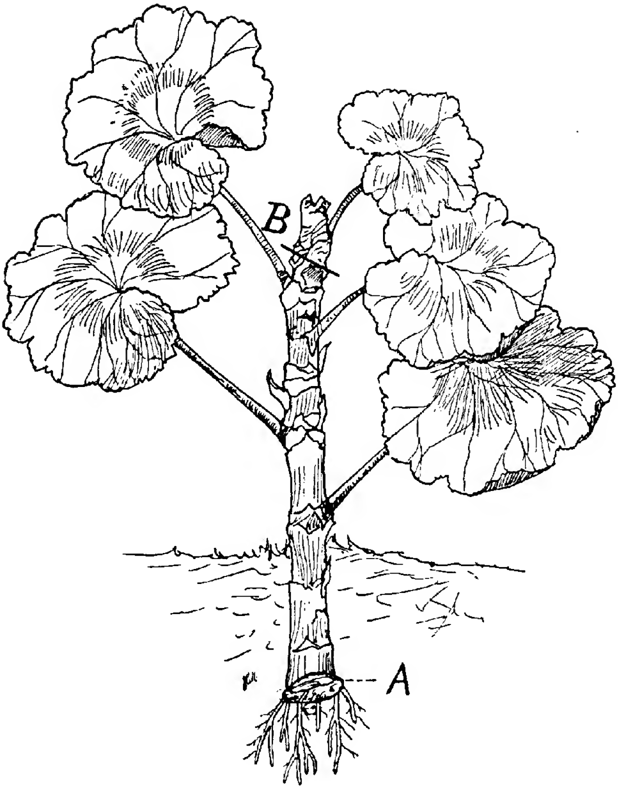

FIG. 9.—Cutting or slip of geranium with short internodes denoting well-seasoned or ripened wood. When a number of roots protrude from the callus as at A, the growing point should be pinched out at B, in order to promote lateral growth from buds in the axils of the leaves, thereby tending to the production of a bushy and evenly balanced plant.

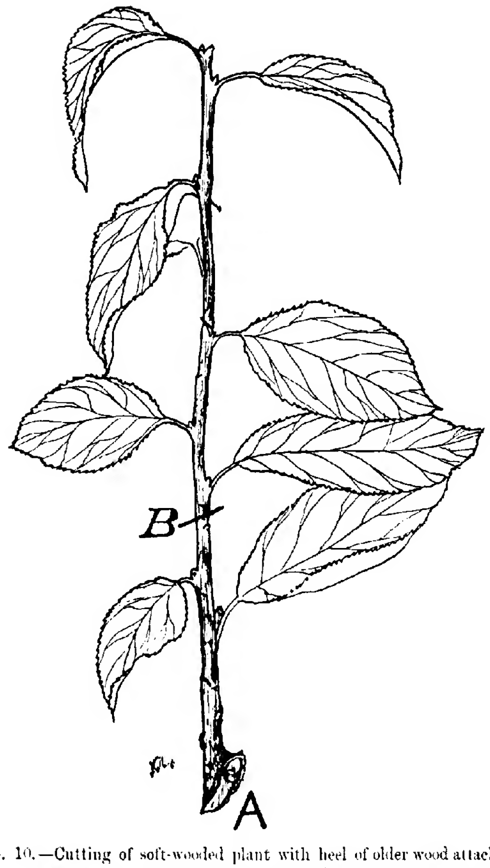

FIG. 10.—Cutting of soft-wooded plant with heel of older wood attached, as shown at A. If the shoot were severed at B and inserted in the ground, the probability is that it would at once shrink and die owing to the pithy and immature character of this younger wood.

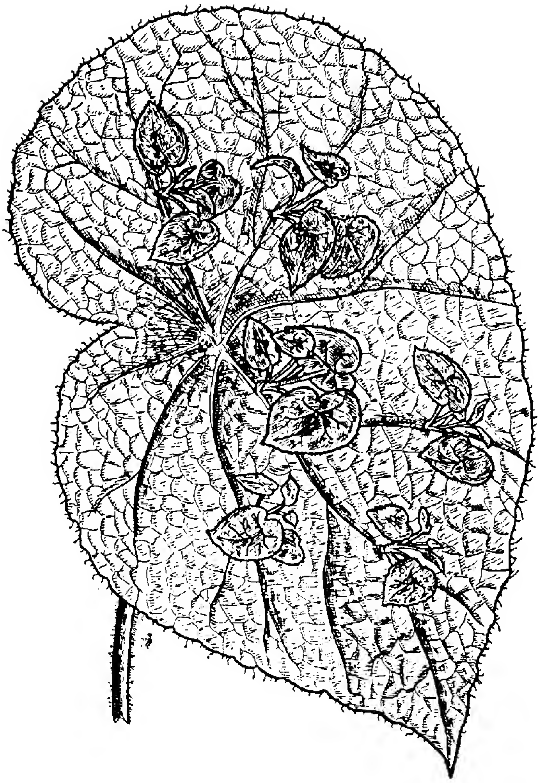

FIG. 11.—Leaf of Begonia Rex, showing position and formation of young plants on an old matured leaf. The thicker the midrib severed, the stronger will be the plant produced. As space is required for the development of the young plants up to the time of their removal, it is well to restrict the number to five or six. Gesnerias, Begonias, and Streptocarpus may be similarly treated.

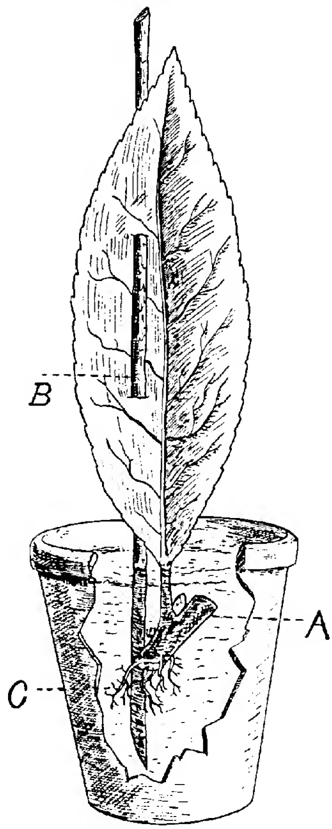

FIG. 12.—Method of propagation by eyes with leaf and portion of stem attached. *Dracænas*, *Codiæums*, *Ficus elastica*, and many other plants may be treated in this way.

A, Portion of stem with bud and leaf attached.
B, Stake to keep cutting in position.
C, Roots being emitted from base of cut stem.

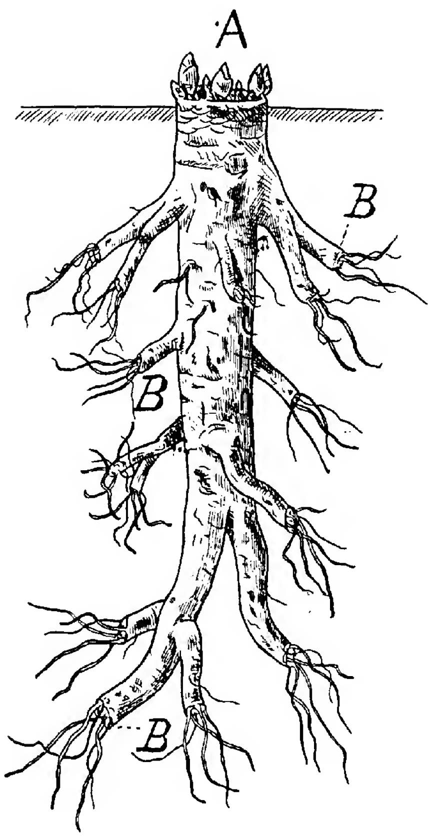

Fig. 13.—Root cutting, showing formation of young buds on cut surface at A. When too numerous these buds are reduced in number by rubbing off those not required; in some cases, as in seakale, only one bud is allowed to develop. B, Bunches of young fibrous roots being emitted from where the old roots were severed. Romneyas, Yuccas, Pelargoniums Bouvardias, *Cæsalpinia japonica*, and *Clerodendron trichotomum* are examples of plants that may be increased by this method.

Fig. 14.—Propagation by layering.

A, Young shoot of carnation.
B, Showing point and method of making incision.
C, Base or root-stock of parent plant.
D, Wooden peg to keep layer in position.

When sufficiently rooted the layer is completely severed from the parent plant at E.

Care must be taken to see that the incision is kept open: this may be effected by means of a small wedge of wood or stone.

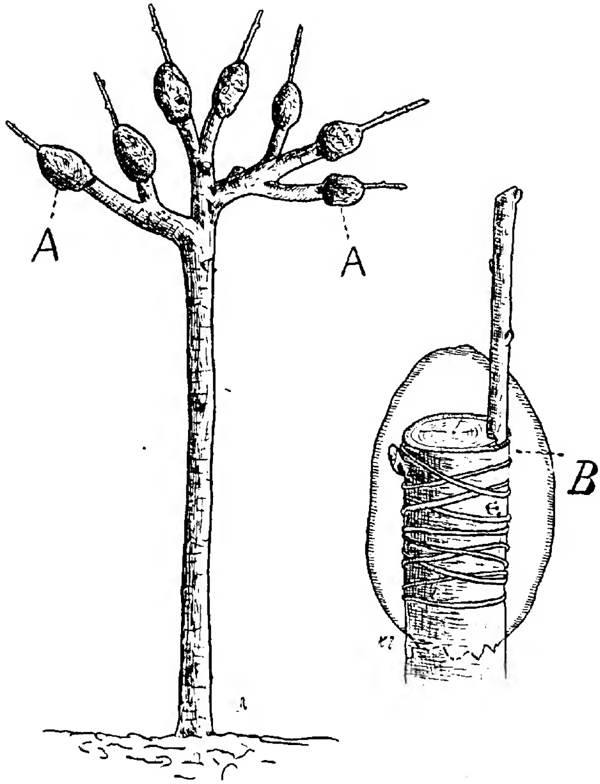

Fig. 15.—Standard apple headed or cut back early in the year in readiness for grafting in March or April; a common practice where a particular variety does not succeed.

Crown grafting as shown at A is resorted to, and in some cases two or even three grafts are inserted; but when the branches are numerous and the stock young and healthy, one graft to each limb is usually sufficient.

B, Showing method of inserting graft and covering with clay or grafting wax.

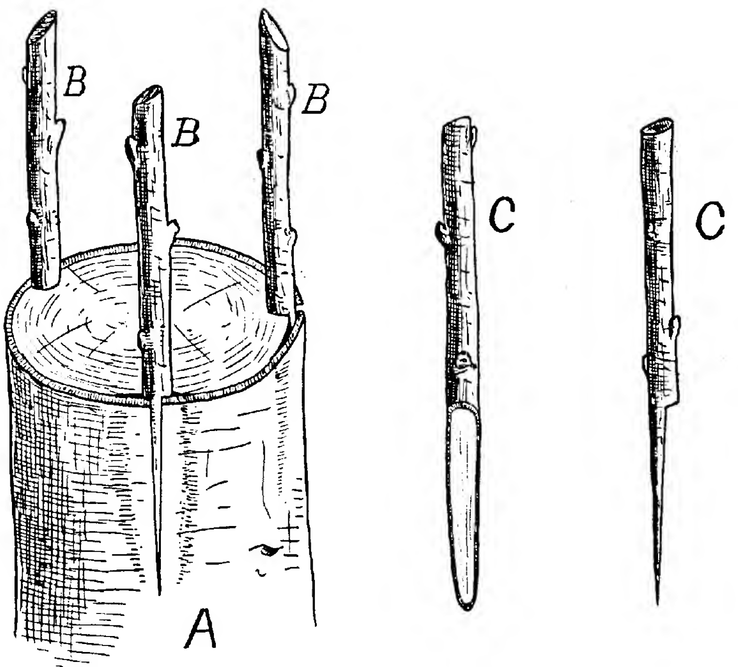

FIG. 16.—Crown grafting. Method adopted in grafting large trees where the thickness of the bark does not admit of the cambium layer of cells coming in contact with those of the stock by the more general methods, such as whip, notch, cleft, or saddle grafting.

A, Stem or stock of medium-sized tree.

B, B, B, Scions, or grafts, three of which are usually inserted, in case one or more should fail to make a union.

C, C, Side and full view of graft, to show method of cutting.

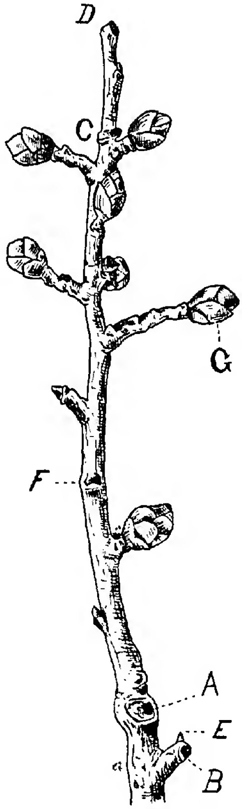

FIG. 17.—Twig or branch of pear, showing three seasons' growth.

A, Point at which the shoot was pruned.

A to C, Growth made by the terminal bud, along the extension of which fruit and wood buds are irregularly placed.

B, Scar denoting the position of last season's fruit, after the removal of which a small wood bud, E, has made its appearance.

C to D, Growth of the terminal wood bud which, owing to the excessive development of fruiting buds along the extension of the branch, is weak; it has been shortened at the winter pruning.

F, Wood-bud.

G, Fruit-bud.

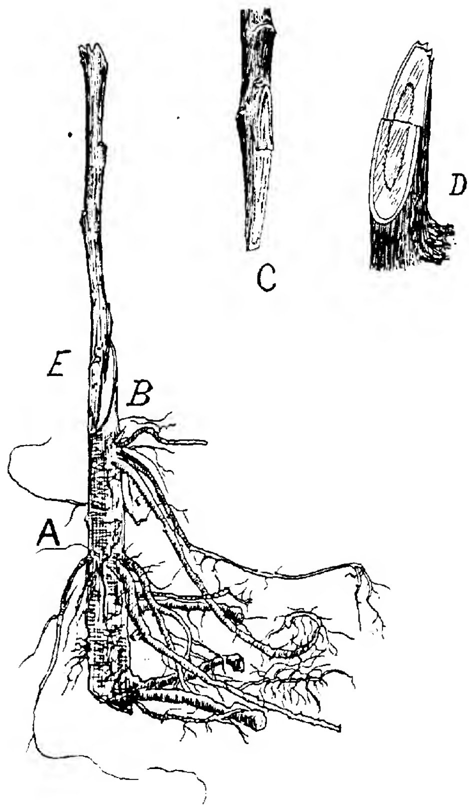

FIG. 18.—Whip or tongue grafting.

A, Young Paradise stock headed back at B.
C, Method of cutting and tonguing graft.
D, Incision made in stock.
E, Appearance of graft and stock when in position, previous to tying and covering with grafting wax.

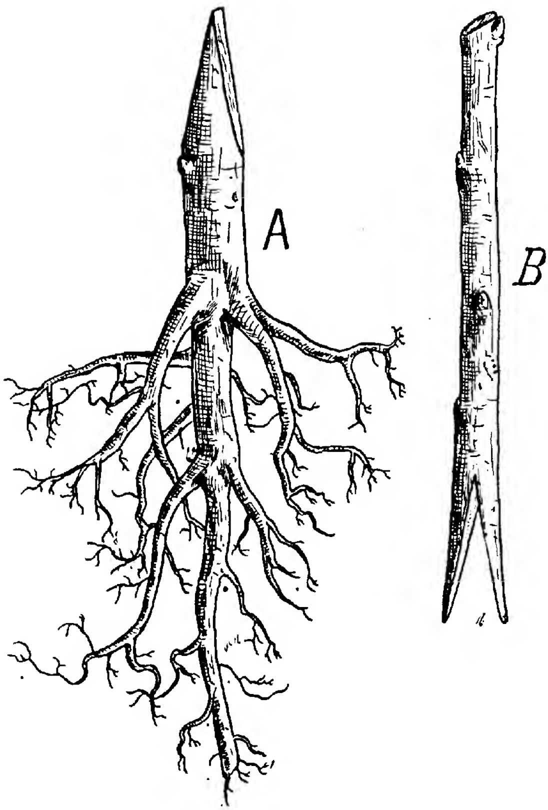

FIG. 19.—Saddle grafting.

A, Root-stock, in readiness to receive graft.
B, Graft, showing position of buds and method of preparation.

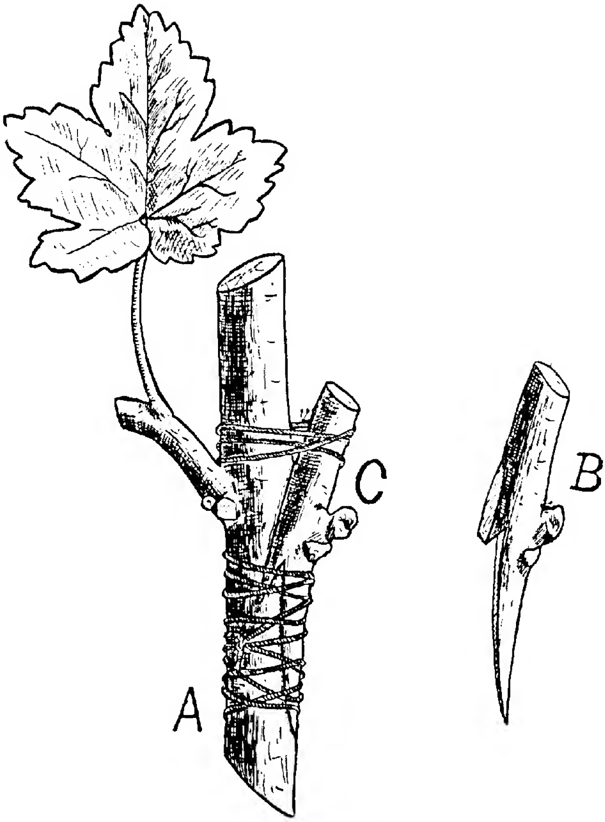

FIG. 20.—Side grafting, as practised in the vine.

A, Stem of vine.
B, Prepared graft.
C, Graft in position and tied before waxing.

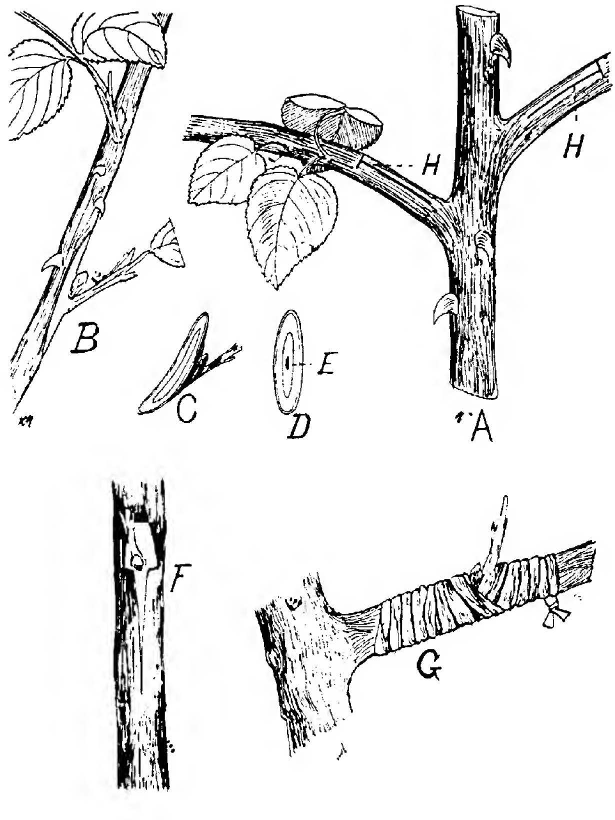

Fig. 21.

A, Rose stock, showing incisions H made on lateral branches.
B, Method of removing buds from ripened growth.
C, Side view of bud.
D, Back view after removal of wood from bark, the point E denoting the base of the bud.
F, Insertion of the bud on the stock.
G, Showing branch when completed. The bud should be placed as near to the main stem as is possible; much more so than shown in G.

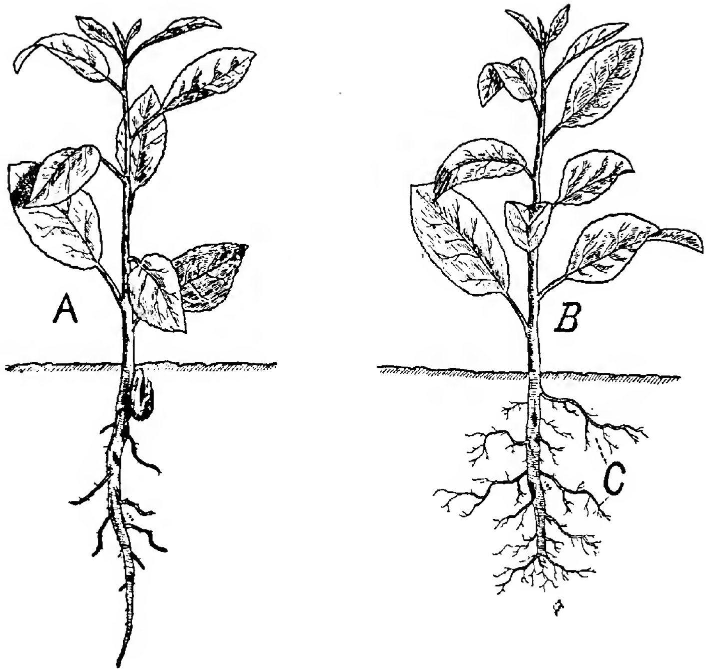

FIG. 22.

A, Young seedling tree, showing development of tap root with a few secondary or lateral roots attached.

B, Same plant after tap root has been shortened: note increased development of fibrous roots at C.

The checking of the primary root induced the stem above ground to become branched or forked.

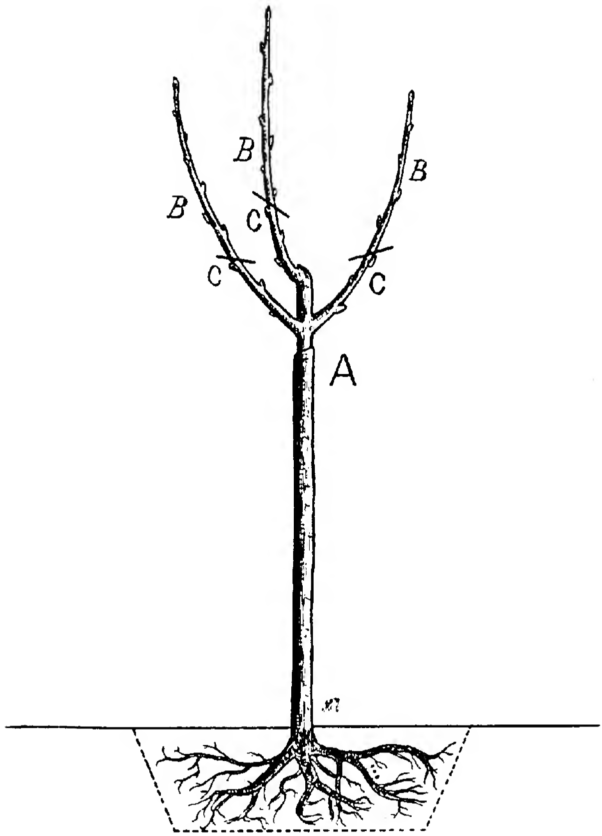

FIG. 23.—Young standard fruit tree.

A, Point of union between stock and graft.

B, B, B, Developed buds of graft forming the three strong branches, which in the second year are each pruned at C, C, and C to two, or if thought necessary, to three buds pointing away from the centre of the tree, so that in the following year the tree will assume a form somewhat similar to that shown in fig. 24.

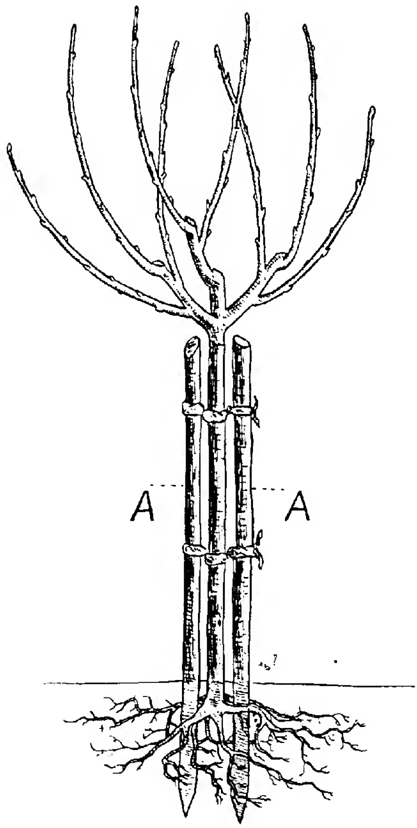

FIG. 24.—Appearance of young standard tree, showing pruning of the branches the second year after grafting.

A, A, Two or three stakes should be used to keep the tree in position, and to prevent its being rocked about by the wind.

Small meshed wire-netting is employed where rabbits and hares prove destructive to the bark.

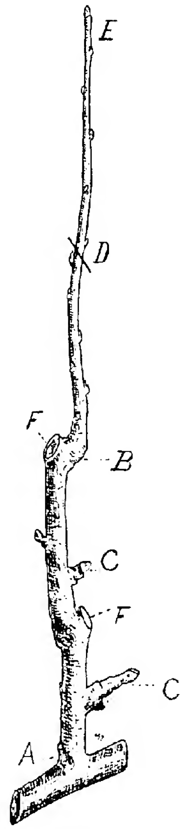

FIG. 25. Branch of apple.

When it is desired to furnish a branch with fruiting spurs along its entire length, sufficient of the season's growth must be removed to ensure the development of what would otherwise be dormant buds were the whole or greater portion of the growth allowed to remain. Usually about two-thirds of the current year's growth is removed.

From A to B represents two years' growth.

To obtain another or third length of stem, remove the portion from D to E and so on each successive year until the required length is attained, when the branch can be kept pruned back to a fruit bud or spur.

F, F, Scars remaining after removal of shoots at winter pruning.

C, C, Fruit buds.

FIG. 26. In order to convert a strong wood growth into a fruiting spur it is necessary to check the flow of sap by twisting the extremity of the shoot as at A. This will have the effect of stimulating lateral buds into growth as in B. If these are in turn checked by pinching, other laterals will make their appearance towards the end of the season. The whole object of repeatedly checking this strong wood growth is to weaken the shoot and to induce the formation of fruit buds. At the winter pruning the shoots will be shortened or spurred back as shown in C.

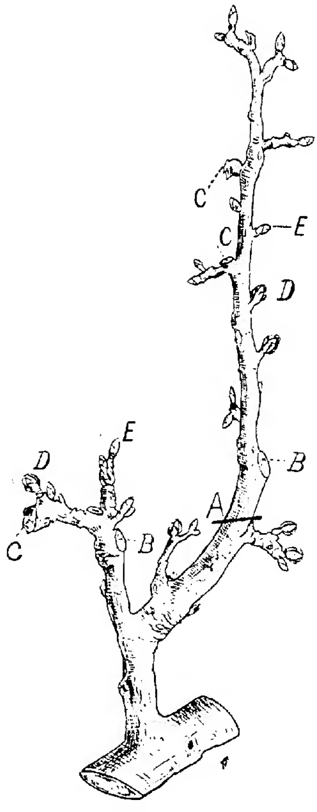

FIG. 27.—Typical fruiting spur of pear.

A. Point to which the spur may be shortened to prevent its extending too far away from the main branch.
B, B, Points at which pruning has previously taken place.
C, C, Scars denoting position of last season's fruit.
D, D. Fruit buds.
E, E, Wood buds.

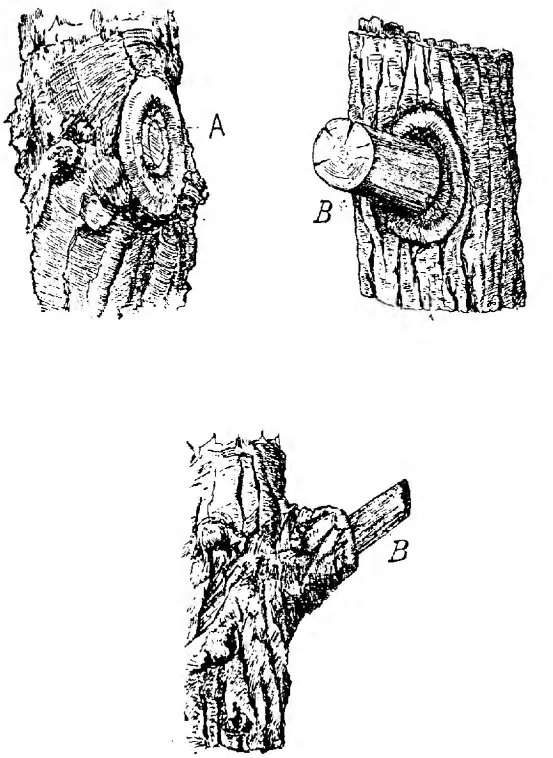

FIG. 28.

A, Represents the healing over of a wound after the removal of a large branch by sawing it off as close as possible to the trunk.

B, When the branch is left to rot the snag prevents the wound healing, while very frequently the decay is continuous from the snag into the heart wood of the tree and so detracts from its commercial value as a timber tree.

Large limbs should be removed in pieces in order to prevent tearing the bark of the tree; this is effected by sawing the limb upwards a little way from beneath.

All large cuts should be dressed with gas tar.

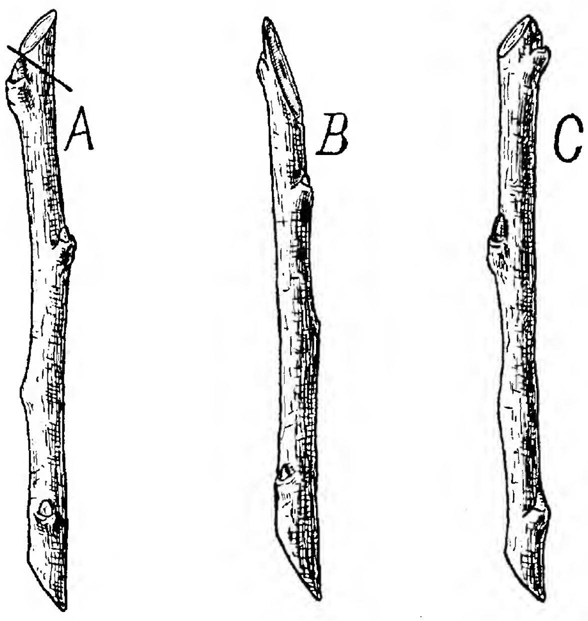

Fig. 29.—Wrong and right methods of pruning.

When the branch to be removed is not cut in the direction of a bud a snag is formed, as shown by the line at A.

If a cut is made too low down, or below the bud, the elaboration of sap is interfered with and very often the bud does not develop, or if so, very weakly.

The illustration C shows a correct cut, and one which must always be performed whenever a young wood growth is removed, and the terminal remaining destined to become a leader.

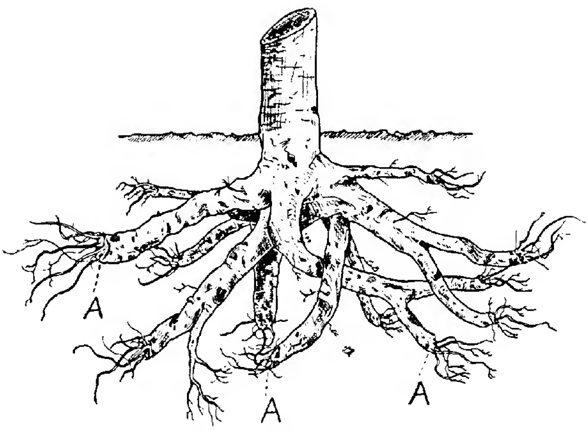

FIG. 30.—Appearance of root and stock of apple one year after pruning. Young vigorous trees often make strong roots which penetrate into the subsoil, and are devoid of the more useful fibrous roots which are conducive to fruit-bearing and take their nourishment from the warmer and more nutritive surface soil.

A, A, points at which old roots were severed.

Young trees with few strong roots must be carefully treated; otherwise the succeeding year's growth receives a severe check.

FIG. 31.—Fruit may develop at the base of a terminal or extension growth, as at A, necessitating its immediate removal.

The bud B will in all probability develop into a fruiting bud the following year; or, if not, into a weakened shoot which will eventually form a spur.

C is an extended fruit growth beyond which a wood bud has developed and should be removed. At the winter pruning this elongated shoot C would be better shortened back to induce a spur-like growth nearer to the main stem.

Here, as in fig. 25, three seasons' growth is represented.

FIG. 32.—A typical fruiting branch of young apple.

The leader A is being partially stunted by a basal fruit spur B, also by the general prolific condition of the whole branch.

Where branches have developed to their full length, then no better condition could exist than that shown in the diagram.

C, Fruit spurs.

D, Fruit scars.

E, Long spur requiring shortening at F.

G, Fruit bud.

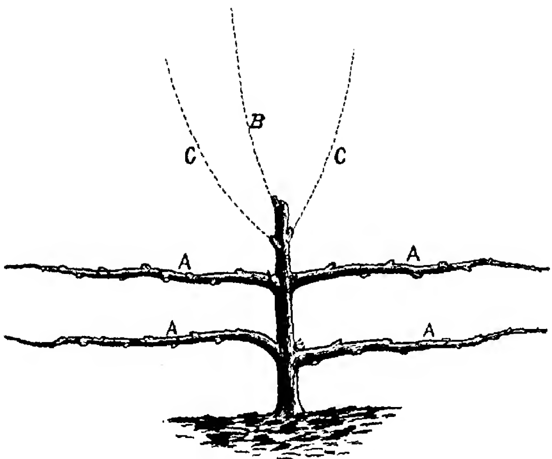

FIG. 33.—Young espalier tree with two pairs of horizontal branches, A, A, A, A.

When laying in successive branches remove all surplus buds from the leading branch, selecting three well-placed buds, to form a leader B, and two lateral branches C, C.

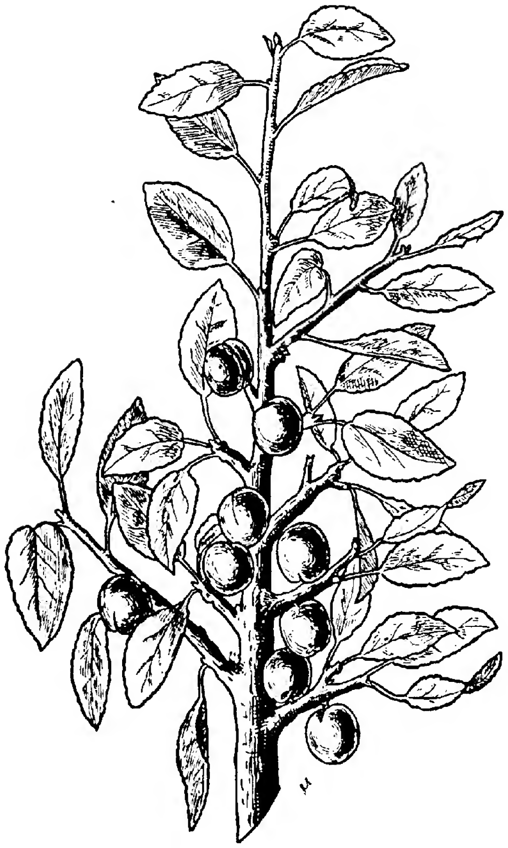

FIG. 34.—An old fruiting branch of apricot, showing position of fruit on the older wood.

FIG. 35.—Branch of cherry from old matured tree showing three years' growth.

A, Naturally formed spurs with clusters of flower buds.

B, Wood bud.

Where an extension of the shoot is desired, it will be necessary to prune to a wood bud as at C.

FIG. 36.—Branch of Kentish Morello cherry, showing natural growth of young tree.

To induce fruiting spurs the lateral branches should be pinched or shortened back when young, as shown at A.

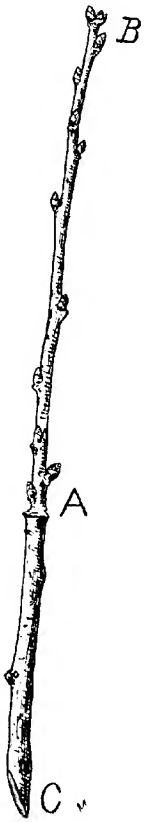

Fig. 37.—Shoot of Morello cherry. Showing two seasons' growth.

A to B, Young wood upon which fruit is borne, and must therefore be shortened back.
C to A, Wood of preceding year's growth.

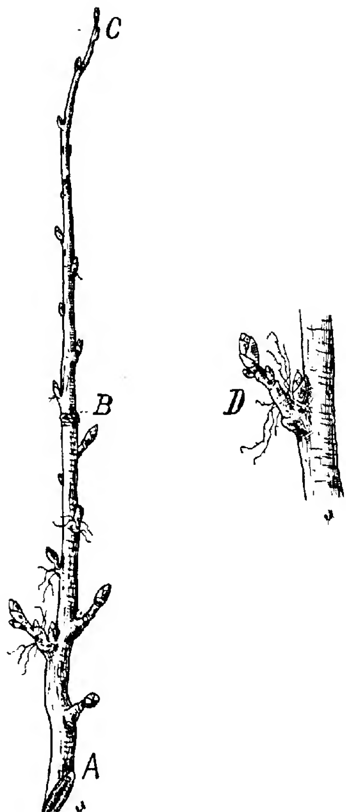

FIG. 38.—Shoot of black currant. Showing formation of young wood and fruiting spurs.

A to B, Young wood of previous season's growth, with leaf- and fruit-buds.
B to C, Current season's growth.
D, Fruiting spur enlarged.

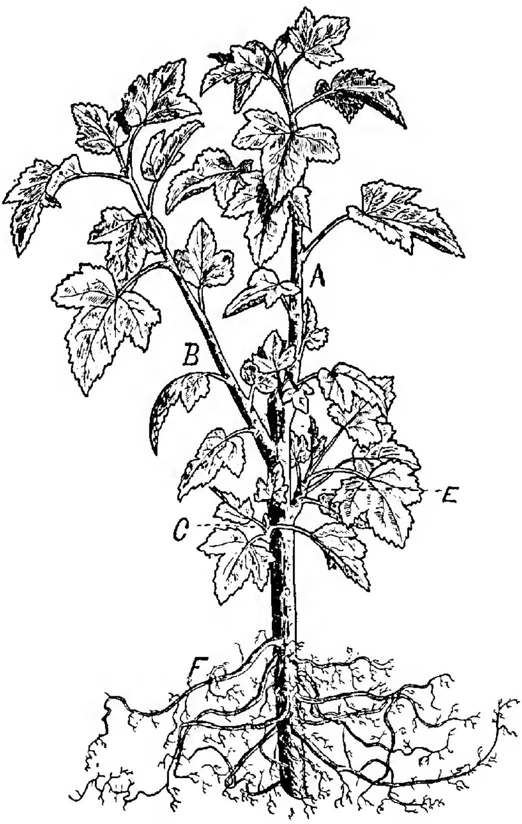

FIG. 39.—Cutting of red currant. Showing development of dormant buds in spring.

A, Strong growth made by terminal bud.

B, Almost equally strong growth made by second bud from apex.

C and E, Remaining buds, which have only had just sufficient strength to push forth a few leaves. These latter buds may extend in length when the two leaders are headed back at the winter pruning, but very often they bear fruit and remain stunted.

F, A mass of roots produced during the autumn and spring following insertion of the cutting.

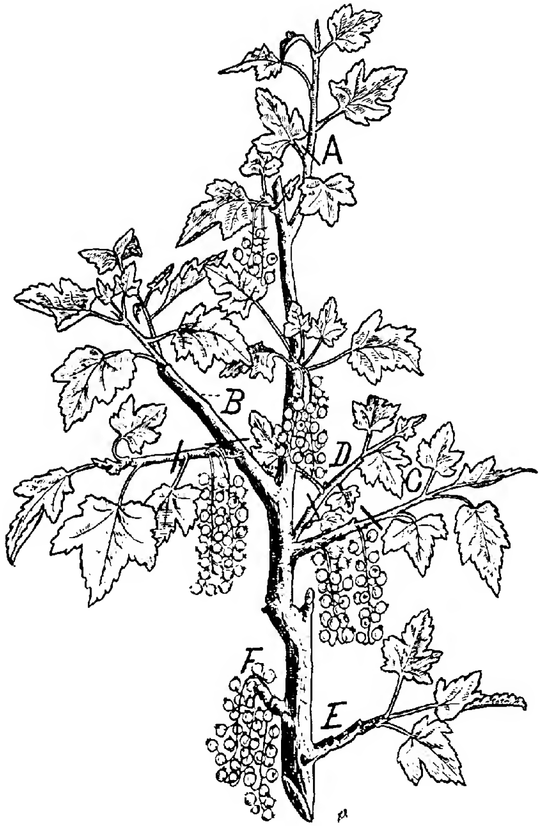

FIG. 40.—Fruiting branch of red currant.

When the bush is fully grown, the main branches are stopped or pinched back in a manner similar to that recommended for laterals.

A, Terminal lateral growth produced through stopping the lateral branch.

B, A strong competitive branch which should have been kept pinched back to the main stem.

After checking a lateral growth, C, a new shoot, D, often breaks from the base of the lateral.

E, A short, stubby growth or spur which need not be pruned.

F, A similar spur bearing fruit.

At the winter pruning cut back to two or three buds, as indicated by cross lines.

Fig. 41.

A, Natural growth of fig.

When desired to arrest the growth of a main or lateral branch, the extremity of the shoot is removed at the fifth or seventh leaf; the resulting growth usually being left intact, unless making more than two or three leaves. Where no room admits of training laterals, they should be nipped clean out when quite young.

B, Portion of branch showing fully developed fruit.

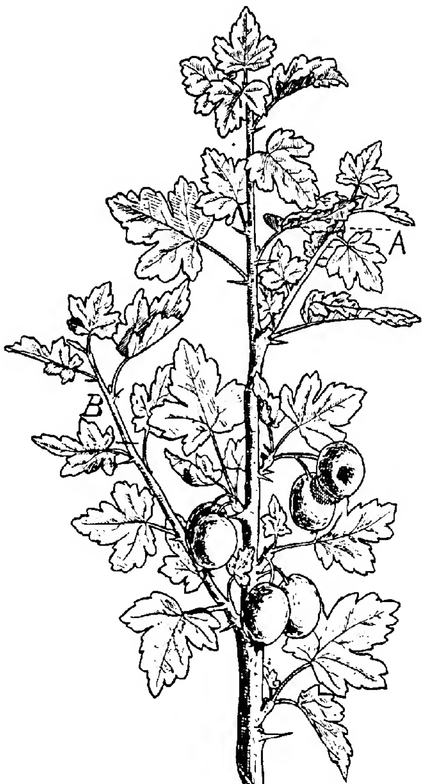

FIG. 42.—Fruiting branch of gooseberry.

If the extremities of the lateral growths A and B are pinched back to about the fifth leaf in early summer, the buds near to the base are strengthened.

C, Fruit borne on wood of preceding year's growth. At the winter pruning the spur should be still further shortened, or spurred back as in Fig. 43, B.

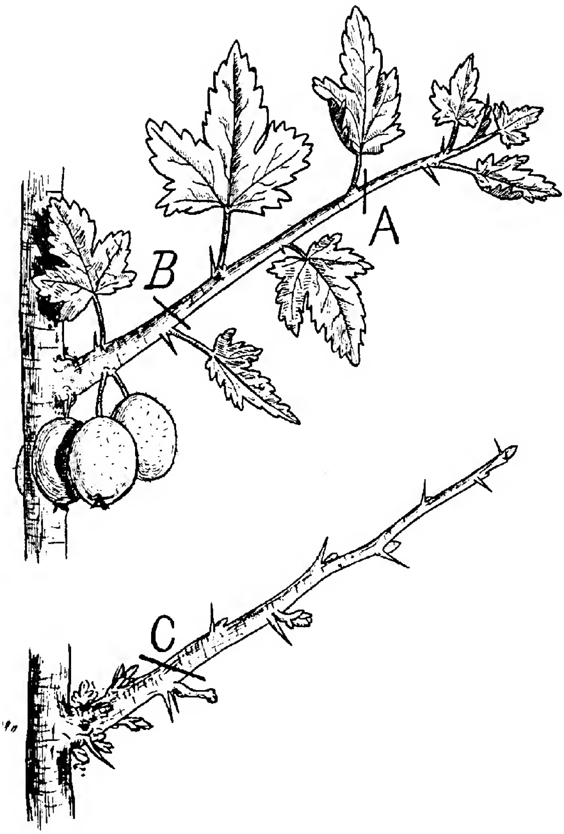

FIG. 43.

In the summer pruning of the gooseberry the young shoots of the lateral growths are pinched out at about the fifth leaf as at A; when at the winter pruning they are severed closer to the stem as at B. The effect is to produce a well-developed spur as shown at C on the leafless shoot.

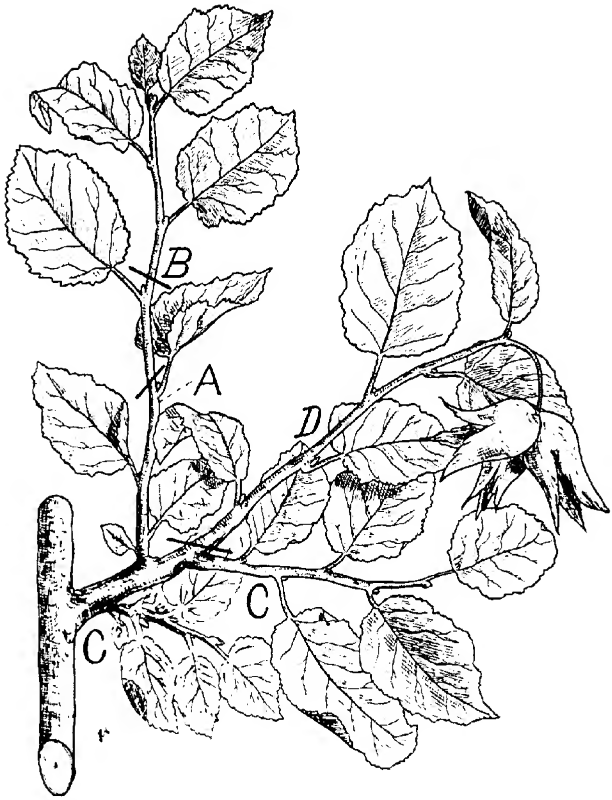

FIG. 44.—Growth of filbert shoot which has been subjected to winter pruning.

Long shoots, like A, may be checked by breaking or twisting at B in summer; while short, stubby growths, like C, C, need not be touched at the summer or winter pruning. A fruiting shoot like D is best removed at the point D in winter, while the shoot A should be shortened at A.

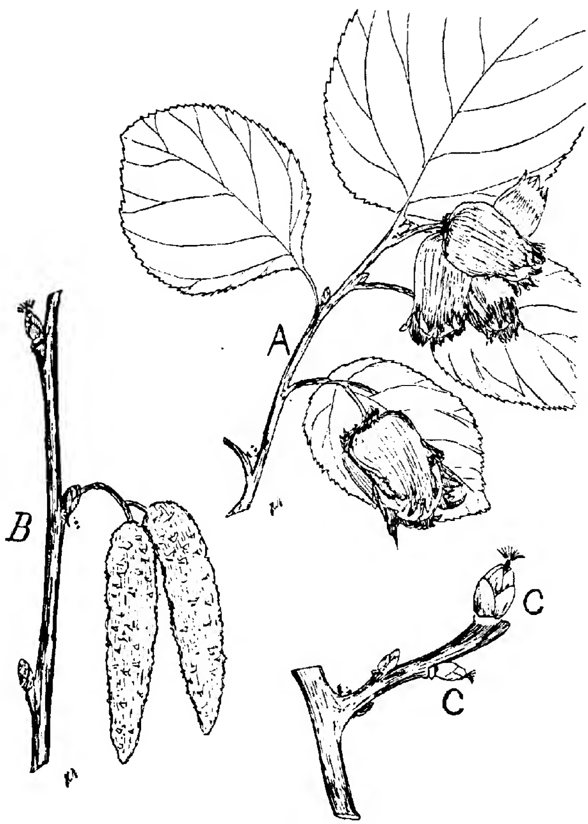

FIG. 45.—Typical growth of cob nut.

A, Fruiting branch.
B, Shoot with male (catkins) and female flowers.
C, Female buds in flower.

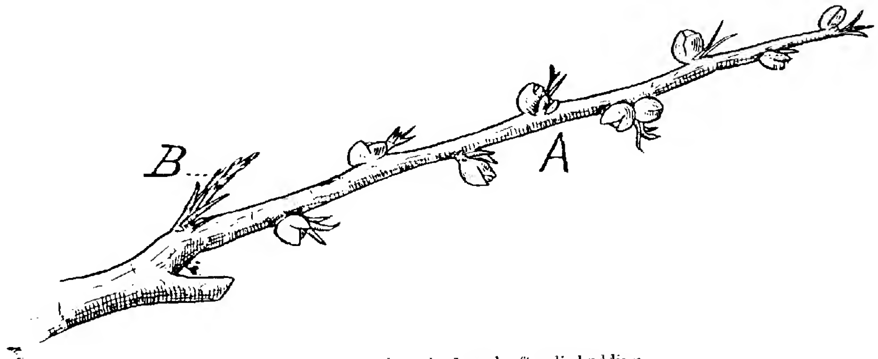

Fig. 46.—Fruiting branch of peach after dis-budding.

A, Dis-budded shoot.
B, Young shoot which in the following year will take the place of the one now fruiting.

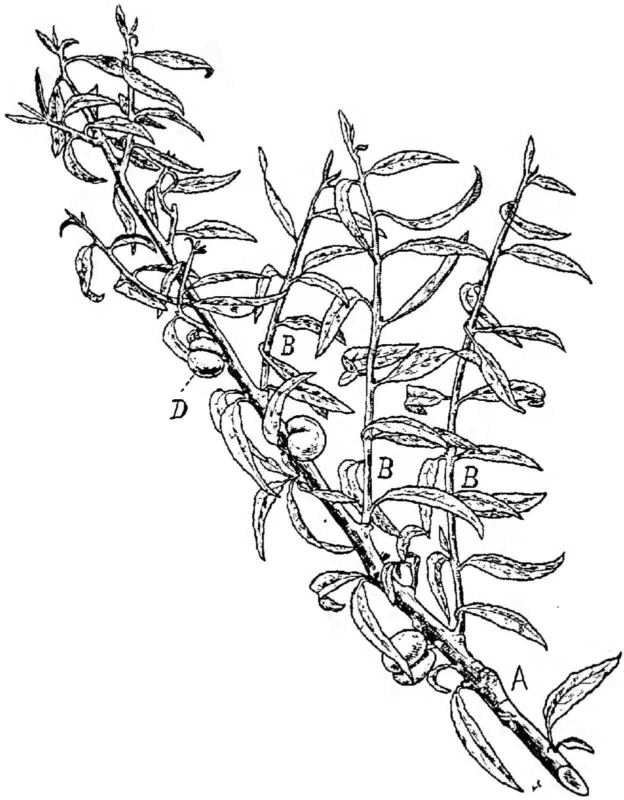

FIG. 47.—Branch of peach.

The growth of the branch A should be shortened above the fruit, first to three or four leaves, and later to one or two leaves. The successional shoots B, B, should be stopped when from 12 to 15 inches long.

C, Laterals and sublaterals resulting from the removal of the terminal growth. When one strong lateral is trained for succession the whole of the fruiting branch is removed.

D, Stoned fruit, two or three being ample to leave on one branch, otherwise quality cannot be attained.

Successional shoots of peach and nectarine should not be stopped unless unduly strong.

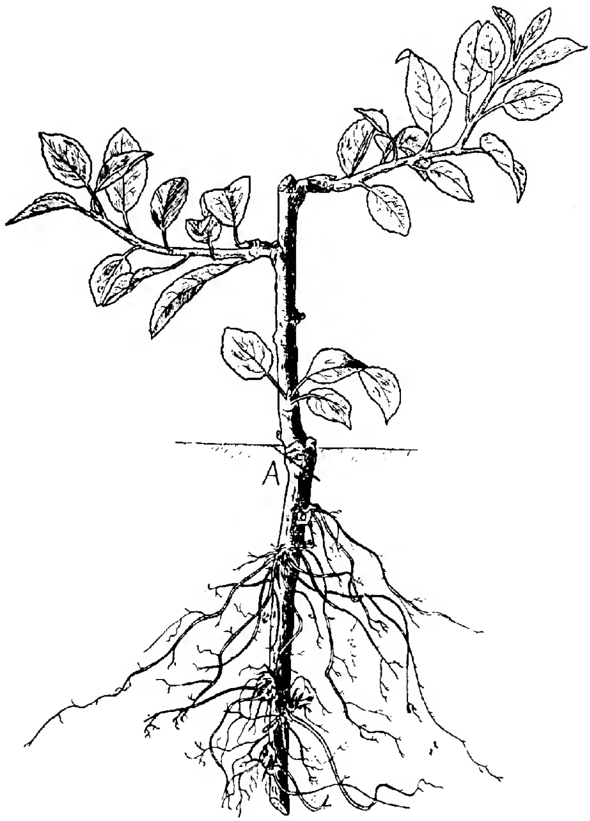

Fig. 48.

Quince stocks from cuttings make an abundance of fibrous roots below the surface, while that portion above the ground-line produces woody growth. It is customary to cut or head back the stocks a month or so previous to grafting. If root-grafted the stock is finally severed at the point A.

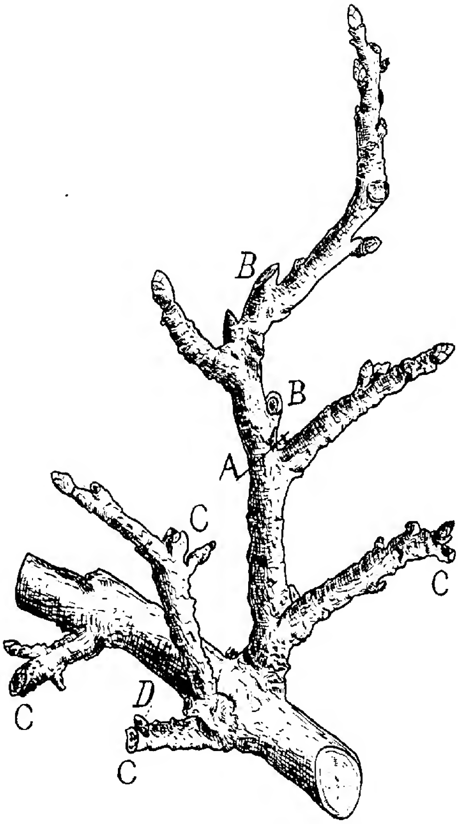

FIG. 49.—A fruit spur from old tree, showing how by degrees the spurs extend in length and away from the main branch.

To induce the formation of a shorter spur remove at the winter pruning the portion above A.

B, B, Points at which the spur has been previously shortened.

C, C, C, C, Scars remaining after removal of fruit.

D, Bud forming below scar, and which will ultimately form a fruit bud.

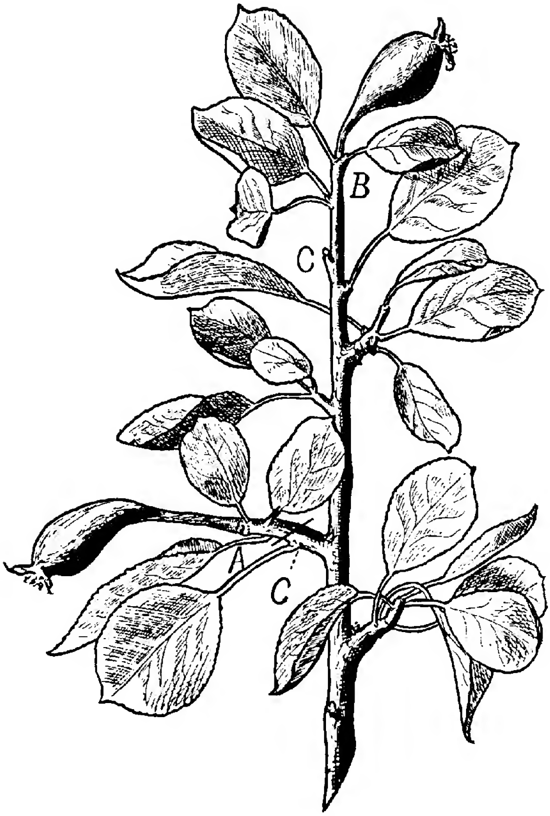

FIG. 50.

It not infrequently happens that extension branches are prevented from developing owing to fruit being allowed to form on the buds just below the leader, or it may even happen that the terminal bud is a blossom bud and so develops a fruit, with the result that this particular branch ceases to make any further extension.

The above drawing from nature shows two such growths. The flowering buds at A and B should be pinched out as soon as detected, and at the winter pruning shortened back to a wood bud as at C, C.

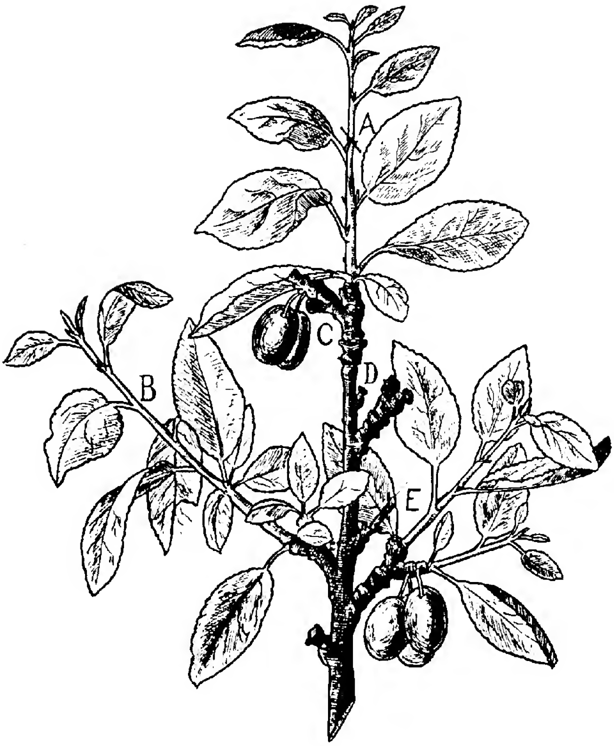

Fig. 51.—Fruiting branch of plum.

The terminal growth may be shortened back to A at the winter pruning. Any lateral growths, such as B, when not required for extension, are best pinched to the third leaf.

C, Fruiting spur; fruit being borne on wood of previous season's growth.

D, Old inactive spur, which at any time may develop growth on which fruit is borne in due course.

E, Spiny growth showing formation of fruit buds at base.

FIG. 52.—Raspberry, showing old fruiting canes, A, A, together with young canes, B, B, upon which the next season's fruit will be borne. As soon as the fruiting season is over the fruiting canes must be cut out close to the ground, as indicated by horizontal lines; this admits of the young, soft wood becoming matured by the admittance of air and sunshine.

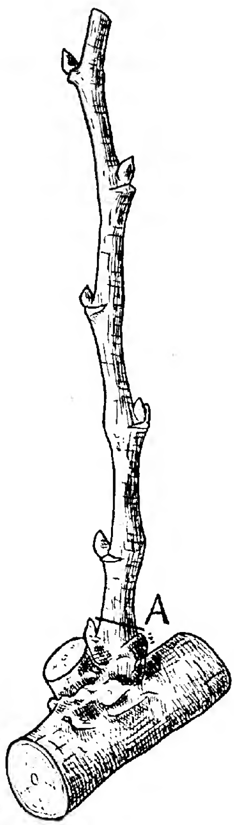

FIG. 53.—Vine shoot of three years' growth, showing proper method of pruning. At the winter pruning the cane will be cut back at the point A.

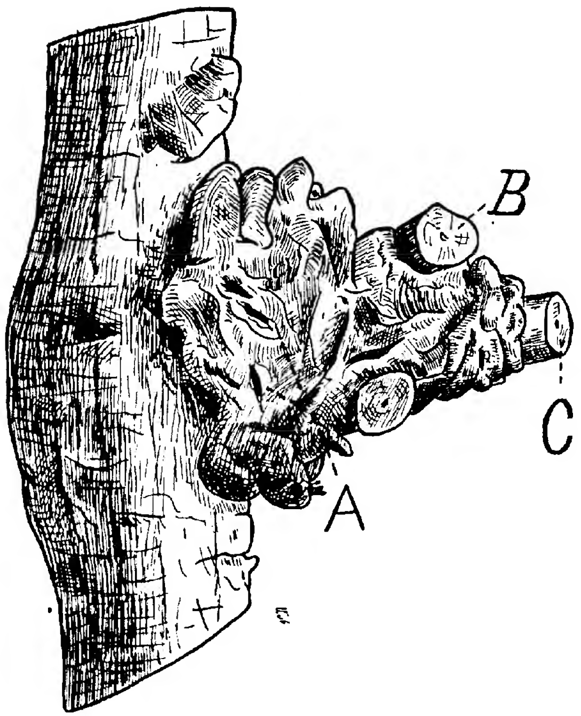

FIG. 54.—Typical spur from old vine, representing ten years' growth.

A, Scars remaining after the removal of branches, and now becoming almost obliterated.
B, Cut surfaces of more recent date.
C, Method of pruning current year's growth.

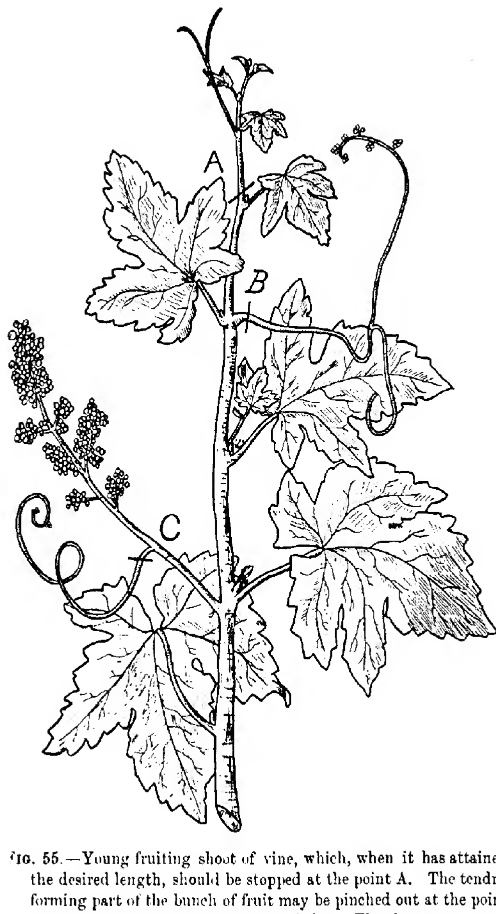

FIG. 55.—Young fruiting shoot of vine, which, when it has attained the desired length, should be stopped at the point A. The tendril forming part of the bunch of fruit may be pinched out at the point B, as also should the bunch or tendril C. The shoot must never be allowed to become so hard as to require a knife being employed in its removal. Laterals will make their appearance as a result of this check, and must be similarly treated throughout the growing season.

Fig. 56.—Seedling briar previous to budding.

Any secondary or sucker growth should be cut off close to the stem, as at A, before the operation of budding is proceeded with.

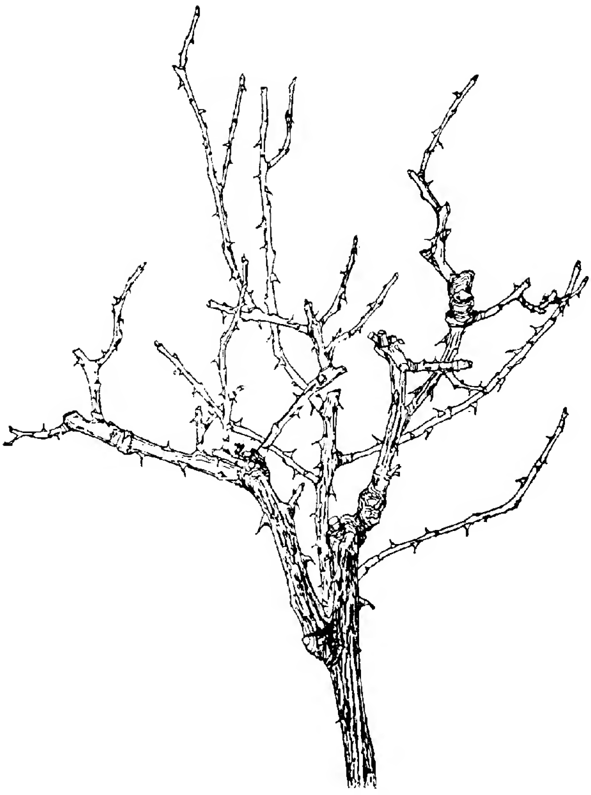

FIG. 57.—Appearance of standard rose tree after pruning. As much old wood as can be reasonably spared should be cut out and the tree kept in as symmetrical a form as possible.

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